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REMODELING LIGHT AND POWER SYSTEMS.

An unusually interesting article will be found in this issue descriptive of the system of the New York & Staten Island Electric Company. The interest consists not so much, perhaps, in the mere work, for other lighting and railway plants and networks have been merged before this, but in the peculiar conditions that have combined to create elements of difficulty. While dealing essentially with an urban population, the company has had to operate in rural regions close to the sea, very hilly, with houses greatly scattered; and has to meet the present situation with a mass of unrelated and inharmonious apparatus, good in itself, but of almost hopeless difference in function and characteristics. Its problems are, indeed, those of all systems that have to be unified for the sake of simplicity and better service to the community, but those who know Staten Island and its electrical history realize that the work there has been very onerous. There is a report that the company, in its efforts and its large expenditures, has scarcely secured the public support and sympathy to which it is entitled, but we believe that at no distant date the benefits it is seeking to confer with a modern up-to-date lighting and traction service will be fully appreciated.

POSTMASTER-GENERAL PAYNE.

The selection of Mr. Henry C. Payne, of Milwaukee, as Postmaster General, is an appointment which gives pleasure not alone to his countrymen in general and Republicans in particular, but is noted with much pride by all engaged in electrical pursuits. President Roosevelt will find in Mr. Payne a valuable addition to his Cabinet, for Mr. Payne is far more than a shrewd and able politician. He is a man of affairs, who has been trained in the exacting school of electrical development, and has ever shown himself progressive as the electrical arts and industries with which he is associated have advanced. Beginning with the telephone in its early days he has successively become interested in electric lighting and in electric traction, and with regard to these industrial departments of electricity has been a conspicuous figure. There have been other members of our National Cabinets with electrical interests, but so far as we know, Mr. Payne is distinctively the first manager of electrical properties who has reached the exalted position of active membership in any administration.

The fact that Mr. Payne was once a successful postmaster of Milwaukee and has always been an alert and busy telephone man, renders him peculiarly fit for his new office. But we regret to note that attempts have been made immediately to associate him with schemes for government purchase of the telegraphs of the country. The most circumstantial of these reports insists that the Government proposes to purchase the properties by the issuance of 2 or 2½ per cent bonds. Now, it is obvious that the new Postmaster General must know of such plans if they exist, and be in sympathy with them; in fact, one dispatch from Washington goes so far as this:

"It is said that a bill drawn on the plan indicated will be introduced soon after the holidays by a prominent Administration Senator. It has been reported that Mr. Payne, who is to be the new Postmaster General, is in favor of the Government ownership of the telegraphs. In his published interviews since his selection for this office he has refrained from publicly expressing his views, although he has allowed the intimation to be made that the reports as to his position were correct. If, after his arrival in Washington,

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it should be developed that part of his programme is to carry to a successful conclusion this new Government enterprise, he would be the seventh Postmaster General who has urged and fought for the proposition. The others have been Johnson, Randall, Maynard, Howe, Cresswell and Wanamaker."

With respect to the above and to Mr. Payne's views, we are glad to give his authoritative denial. Having addressed him in regard to this very point since his selection for the office, Mr. Payne has kindly sent us the following communication:

"There is not the slightest foundation for the report which you say is current in the papers regarding my views as to the purchase and transfer of the telegraphs of the country to the Government. I cannot imagine how such a report should have been put into circulation."

This is, it seems to us, sufficiently emphatic to put a quietus on the reports now being circulated, the only object of which would appear to be the creation by speculators of a little boom in telegraph stocks.

Mr. Marconi's Work.

The encomiums bestowed upon Mr. Marconi for his great feat in signaling across the Atlantic by "wireless" methods have been hearty, universal and well deserved. This inventor is a man of high type in his line of work, and possesses to a marked degree the patience, earnestness and dogged perseverance, without which even the grandest ideas in the arts remain useless to humanity. These qualities are indeed such as Mr. Marconi needs in full measure, for notable as his achievement is, much serious work remains ahead of him if further success is to be attained. It is true that the fine work done this month is far beyond a mere "laboratory" experiment; and yet it is not less true that after years of effort no real success has been reached in making the apparatus "selective" or "speedy." Until it becomes both, it cannot very well compete in any sense with ocean cables, although other great fields of service may be open to it.

We regret to note the clash between Mr. Marconi and the Anglo-American Cable people, but it was perhaps inevitable, or due to misunderstandings. The success of the experiment depended, indeed, on cable co-operation, and aside from the scientific aspects of the case, the cable company had rights and obligations that could not be overlooked. Moreover, there is unfortunately reason to suspect that on the part of some persons aware of what Mr. Marconi was doing, an intention existed to gamble in wireless stocks and on the depression of cable properties. Thus the cable companies, while on one hand made to appear before the public in a dog-in-the-manger attitude, found themselves and their properties subject to severe financial assault. While we have no sympathy with their obstructiveness, if it were really all that has been asserted, it must be allowed that they had some ground for indignation and exasperation. In this connection, the oddest spectacle was presented by some persons in New York City, virtually discrediting or doubting the wonderful performance because, apparently, they were taken by surprise by the premature announcement, and hence "got left" in speculative deals with profit in them.

Electrical Measurements of Projectile Speed.

The method of determining the muzzle velocity of projectiles which was formarly in nearly universal use is attributed to Wheatstone. As is well known, it consists in setting up a pair of wire screens across the path of the projectile, one conveniently close to the muzle of the gun, and the other at a convenient known distance beyond, say, 100 meters. Each wire screen is wound with a wire which is in a circuit of a chronograph, and the projectile, when fired, cuts first one wire and then the other, the time between the two cuts being automatically registered on the chronograph, and thus furnishing a measure of the mean velocity between the two screens. This method has been further perfected by the use, in connection with it, of the Crehore-Squier polarization chronograph.

Wheatstone's method, while accurate, has the disadvantage of requiring a new pair of screens, or new wires on the same screens, to be erected after each shot, since the projectile destroys the wire in its passage. A new apparatus, which has largely supplanted the Wheatstone screen, is the Wolf air-shock indicator. It is well known that a rapidly moving projectile, in displacing the air, sends out a conical wave, something resembling the water-wave which is seen to move from each side of the bows of a moving ship. This air-compression wave is a sort of solitary sound wave, thrown out by the projectile, independently of the steady sound which its friction through the air produces. This air wave is relied upon to displace a diaphragm, as the projectile passes and thereby momentarily to open an electric circuit leading to the chronograph.

One such diaphragm is placed near the muzzle of the gun and the other at the required distance beyond. The chronograph record indicates the interval of time between the passage of the wave past the two diaphragms in succession. The advantage of the apparatus is that it does not require to be reset or readjusted after each firing. If the path of the projectile is not quite parallel to the line joining the two diaphragm instruments, a small error may be thereby introduced into the record, but with ordinary care this error is stated to be trivial. The apparatus is adapted for use with large guns and projectiles, and when so adapted is unfit for use with small arms. On the other hand, however, the Wheatstone screens have to be changed when the diameter of the projectile is considerably changed. The new method may, in a certain sense, be regarded as giving a velocity measurement from the microphonic record of the screech emitted by a moving projectile.

Alternators With Dampers.

The article by Mr. Fischer-Hinnen in this issue deals with the theory of "amortisseurs" or copper loops linked with the field circuits of alternating-current machines, on the basis of the theory of induction motors. There can be no doubt that the action of such dampers is closely associated with the action of the short-circuit windings forming the secondary members of induction motors. Consequently, in synchronous alternators provided with dampers, the action of the dampers, considered as the secondary member of an asynchronous machine, is superposed upon the actions of the synchronous alternator. The article deals at great length with the preparatory theory of induction motors, and it would almost seem that much of this induction motor theory could have been assumed, or epitomized, for the purposes of the special case considered. However, the induction motor theory is interesting in itself, as showing the contrast between the modes of thought on this subject in vogue in this country and in Europe. The usual method in this country of dealing with induction apparatus is to consider the inductance of each circuit as that due only to the flux linked exclusively therewith, in contra-distinction to the flux linked both with that circuit and with the associated circuit. The keynote of the induction motor theory expounded in the article lies in the stray flux coefficients and their implication in the general formulæ. The two methods are not in any

way at variance, and lead to essentially the same conclusions, but the difference in the point of view is remarkable.

The article goes to indicate that when an alternator fitted with dampers is being operated by a driving force which rythmically varies, its steadiness of speed must be largely due to the electrical inertia of the damper, and is by no means solely to be ascribed to the mechanical inertia of the flywheel. The increased stability of the machine in parallel running is, in fact, attributable to this electrical inertia. These facts, of course, are generally understood, although the method of treatment here employed seems to be novel. The fact that alternators provided with dampers are thereby reduced in armature reaction, or apparent reactance, under load, is not, however, generally known, and is important. In the last table of the article the statistics indicate that the weight of copper in the dampers on the field is generally in excess of the weight of copper in the armatures, and more than half the weight of the copper on the field magnetizing coils. The conclusion to which the article leads is that it is not worth while incurring so great an expense, since correspondingly good results can be obtained without dampers by employing in the armture winding a part of the copper that dampers would require. While it is possible that this substitution of increased armature copper for the dampers might secure equally good automatic regulation of pressure under load, it does not seem likely that the same substitution would secure equally good stability in running. In other words, it would seem that in order to secure the best stability in parallel operation under sudden variations of speed or load, the effect of the copper in dampers must be greater than the effect of the same amount of copper added to the armature winding.

CHARGING FOR CURRENT.

A long paper read at the last meeting of the British Institution of Electrical Engineers by Mr. Arthur Wright takes up again *in extenso* the matter of the proper method of charging for current, working along the line of maximum demand, as is his wont. It will hardly bear abstracting, but his line of argument is, as those familiar with his system will divine, about as follows: The actual charge for the production of electrical energy in any station is very small compared with the charge which is due to the permanent plant held in readiness for this production. Hence the chief item in an equitable system of charging the consumer is the charge for capacity held in readiness, i. e., the maximum demand. The large preparation charges, mainly fixed charges, are very thoroughly analyzed and made interesting reading for the old-time station manager who figured his cost of energy on coal and labor and trusted to a reorganization after he had unloaded, to take care of fixed charges and depreciation. In a particular case, that of the Brighton station, Mr. Wright shows by an examination of the costs that no less than 72 per cent of the total is preparation cost, that is, cost which does not vary with the length of time the lamps are burning. Hence a vivid illustration of the need of keeping up the load factor if the station is to pay legitimate dividends. He proceeds on the assumption that the plant is a straightforward business enterprise and to be handled as such.

It would be a good thing for every station manager to sit down in cold blood and figure his annual expense after Mr. Wright's methods, and, as a rule, it would be rather a shock to the stockholders to see the results. We do not agree entirely with Mr. Wright's bookkeeping, but his method of segregation is certainly instructive. He classifies as production cost the coal, less all consumed in keeping ready to supply the full capacity when needed, the oil, waste, and supplies including water, less a similar factor, and the repairs to machinery and plant as run. Meter costs, including repairs and attendance, and replacement of fuses, make up what he calls the service cost, which depends only on the number of customers connected. All the other expenses, including fixed charges of every kind, he classifies as preparation costs. Now, based on this line of reasoning a set of charges may be drawn up, showing what each consumer should pay as his proportionate part of each factor of cost. It would obviously show what is generally recognized, that the small consumer using current steadily is a very desirable person to cultivate, while a church, for example, using many lights for a few hours a week only is a costly customer. So far so good, for every one agrees that a steady load as many hours a day as possible is greatly to be desired. But there is another side to the question. A central station is a business enterprise run for the purpose of earning profits, and its methods of bookeeping is a matter that is of no conceivable importance to the consumer. He is willing to pay a fair price for service, but he cares nothing for the load curve of the station, and if he finds that a charge based on preparation costs brings his lights above the cost of gas, or his motor above the cost of a gas engine, he merely says to the manager that he is sorry they cannot do business together and quits. The manager may figure out that it is cheaper to let him quit, but if he is planning to do business on a large scale, the preparation cost still abides with him, and there are instead of inadequate receipts, none. The fallacy of the preparation cost argument if pushed to its conclusion is that such costs cannot be controlled to suit the demand.

If the total preparation cost could be cut up into blocks built up only as they are needed, the problem would be simplified, but in practice a station is built of such size as the business seems to warrant, and the fixed charges steadily hold the fort while the manager wrestles with the task of getting in receipts against active competition from sources which know not the Wright demand system. A condition and not a theory confronts him, and he has to meet it as best he can. It is certain that a good load factor should be built up if a station is to be prosperous, but the exact method of doing it is a matter that must be settled on the basis of local requirements, and we do not believe the same process will work everywhere. If a station is to be organized purely on the demand basis, it will not be well to plan for a large output. In certain cases a demand charge can be made without difficulty, but the customer will not tolerate it if it brings the cost of electricity above its competitive value. In certain places a flat rate, bad as it is in theory, works better than metering, while elsewhere the attempt to work a flat rate simply loses business. The logical thing for a station manager to do is to draw up his load curve and then study his local conditions. He cannot refuse a day service while the gas mains confront him, and he must build up his day load as best he can. He can well afford to take on some load at very near cost if thereby he can withdraw from his competitors some load that will pay him well. After all, the thing which counts when the books are balanced is the average selling price of the product, and that must be kept where it will count against competition. A certain and considerable amount of business at small profit may be a legitimate advertising expense in a live concern. No business enterprise looks after profits more sharply than a modern department store, but it concerns itself with totals, not with a uniform rate of profit on all commodities. There must evidently be considerable latitude in methods of charging for electricity, and while Mr. Wright's system sometimes works well we should dislike to try it on some communities that we know of, particularly against sharp competition. Nevertheless, it sets forth an ideal, and every central station manager would be benefited by following its indications in the determination of true costs, even if local conditions would not permit him to apply the result in the form of a tariff.

November Foreign Trade.

The trade statement for November is encouraging in that the tendencies toward decline are not carried further. Its most notable feature is the continuation of the decline in our trade balance, compared with 1900, that set in largely with the advent of the current fiscal year, although begun last March. Exports for November—$136,511,000—practically hold their own with a year ago, being but $181,000 less. Imports, however, show a substantial gain, being $72,497,000, against $65,354,000 in November, 1900, an increase of $7,143,000. As a result we have for the first four months of the current fiscal year a falling off in excess of exports, compared with 19,000, of $59,924,000; whereas at the end of the past fiscal year the export excess was just $100,000,000 greater than on June 30, 1900.

What encouragement can be found in the statement is that the shrinkage in exports, which marks six out of eleven months of 1901, is but $181,000; and that the $7,143,000 increase in imports, a tendency now continuous since March, is smaller than any since June. This increase in imports really testifies to domestic productive activity, and consequent need of raw materials.

Government Wireless Telegraphy.

Professor Willis L. Moore, chief of the United States Weather Bureau, in his report to the Secretary of Agriculture, says, in part: "Substantial improvements have been made during the past year in the Weather Bureau system of wireless telegraphy. While there is yet much experimental work to be done before our system, or any system of which I have knowledge, is reliable for intership communication, or before any two systems can work within the same field without each rendering the other useless, such progress has been made by the Government experimenters that, with no interference from private systems, stations can be successfully operated over at least 150 miles of coast line, and they are now in operation on the North Carolina and Virginia coasts, and soon will be instituted between the Farallone Islands and the mainland, and the Tatoosh Island and the mainland, on the Pacific Coast.

"If a system of selective telegraphy cannot be perfected so that one system does not interfere with and render useless another, and thereby prevent all use to commerce of recent discoveries in wireless telegraphy, it may become necessary, on account of the value of these discoveries to our marine interests, for the Government to take exclusive control of all systems of ether space telegraphy and to establish stations along our extensive coast lines at such distances and in such relation, the one to the other, that they shall not interfere. Even then there will occasionally be difficulty in communicating with the mainland whenever two ships in close proximity are attempting to transmit or receive messages at the same time."

Electrical Engineers of the Day—XXVI.

Arthur Vaughan Abbott.

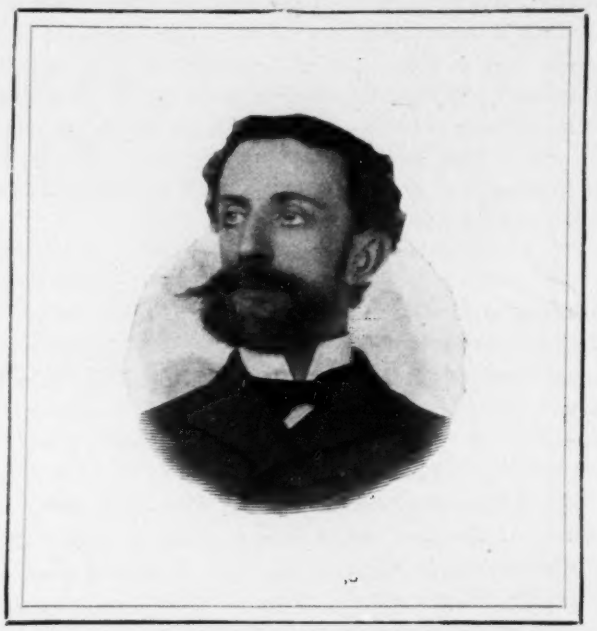
Arthur Vaughan Abbott, who was born in Brooklyn, N. Y., in 1854, is a scion of the family of that name which has given so many distinguished authors and religious instructors to the world. After graduating from the Polytechnic Institute of Brooklyn in 1875 he began work in the Department of Parks, New York City, where he served one year. He then entered the Engineer's Department of the East River Bridge, where he designed and perfected some of the important details utilized in the construction of what was, in certain particulars, at that time an experimental structure. Among these noteworthy inventions and patents were the cable wire splice, wire cutting machinery and testing machines for steel and cement. Mr. Abbott superintended the cable construction, and had general charge of material inspection during a period covering seven years.

After the completion of the famous bridge he built testing machines and large railway and lock scales for E. T. Fairbanks & Co. during a period of four years. Mr. Abbott was then chief engineer of the Boston Heating Company for three years, during which time he designed, installed and operated a plant for supplying heat from a central station over about two square miles of the city of Boston.

As mechanical engineer for the Daft Electric Light Company, Mr. Abbott designed and had charge of shop construction of dynamos and motors, designing, building and operating the electric roads at Meriden, Conn.; Bloomfield, N. J.; Atlantic City, N. J., and Bloomington, Ill., and operating storage battery cars on the Fourth Avenue road, New York City. As a builder of electric roads, Mr. Abbott's experience has been signally successful. Among the roads he built, aside from those above enumerated, may be mentioned the systems of Ogden and Salt Lake, Utah; Augusta, Ga.; the Lake Roland Elevated, Baltimore, Md., and the equipment with electricity of the Interstate Road, Kansas City. As consulting engineer for the Ogden City Water Works, the Bear River Canal and the Waukesha Water Pipe line, he varied his work and added largely to his experience.

In 1892 Mr. Abbott entered upon a long period of telephone construction and reconstruction for the Chicago Telephone Company. Up to June, 1901, he had erected 12 new offices and buildings and relay switchboards, aggregating nearly 40,000 lines; the necessary conduits, underground cables and aerial lines covering the city of Chicago and adjacent territory, aggreating nearly 100,000 wire miles, and the installation of 35,000 subscribers' sub-stations. To have successfully handled work of such magnitude during nine years indicates an excellent business ability, and implies a familiarity and grasp of the management and expenses in detail of all parts of the Chicago Telephone Company. Mr. Abbott has also designed, installed and operated lighting plants on all systems aggregating 10,000 lamps.

But perhaps Mr. Abbott's chiefest claim upon the public attention (saving one to be considered later) lies in his authorship of a



widely known engineering treatise entitled, "The Electrical Transmission of Energy." This work involved an extraordinary amount of application in its achievement, and of experience for its conception and realization. It has been translated into German and is used as a text book in many American and European universities. Mr. Abbott has also written smaller works of value, namely, "A Treatise Upon Fuel," and "Testing Machines," besides numerous magazine articles and professional papers.

The chief claim upon the public appreciation and appraisement of Mr. Abbott's merit as an engineer, however, lies in his fidelity to his ideals, and his unwavering refusal to do unworthy or perishable work. The writer has frequently heard him speak with horror of the Ashtabula Bridge disaster, and the suicide of the engineer because the faulty construction of the bridge had precipitated so many unsuspecting souls into eternity; and Mr. Abbott has ever affirmed that an engineer's conscience and his religion should manifest itself in the integrity and virility of his work for the people. The doing of the world's work rightfully involves a conception of the organic nature of society and the responsible and intelligent effort that is necessary in every department to secure a frictionless and rhythmical adjustment of the large life to the larger movement; and in this particular Mr. Abbott's work suggests a model standard to all his brother toilers, whose science and art and labor it is to utilize and distribute the forces and materials of nature.

Mr. Abbott is a member of the American Institute of Electrical Engineers and of the Institutes of Mining and Civil Engineers.

Lighting and Railway Development on Staten Island.

BY MAX LOEWENTHAL, E. E.

EVER since its admission into the sisterhood of boroughs, constituting the great city of New York, Staten Island, now known as Richmond Borough, has made wonderful strides in its lighting and railway facilities.

Staten Island, with a population of about 70,000, is situated about five miles south of Manhattan Island, from which it is separated by New York Bay, while the Narrows separate it from Long Island on the northeast, Staten Island Sound from New Jersey on the west, and Newark Bay and the Kill von Kull from the same State on the north. It is of an irregular triangular shape, its greatest length being about 13 miles, its greatest breadth about 8, and the total area about 58½ square miles. The entire island is traversed by roadways and turnpikes, and a large number of towns and villages are scattered throughout its territory. It must be noted, however, that it is the north shore which is most densely settled, it being along this shore and the eastern shore that the main line of the steam railroad and the trolley lines run. The chief towns in this district are Clifton, Stapleton, Tompkinsville, New Brighton, Snug Harbor, Livingston, West Brighton and Port Richmond. The chief town at the southwestern end of the island is Tottenville.

FIG. 1.—MAP OF STATEN ISLAND SHOWING LIGHTING AND RAILWAY CIRCUITS.

On this entire island only one electric light and power company holds sway, which, like a Phœnix, rose out of the ashes of a number of other companies, whose works were either burned down, never completed, abandoned or absorbed. This company, called the New York & Staten Island Electric Company, owns in the neighborhood of 2000 miles of lighting circuits, supplying current for 4000 series incandescent lamps and 500 arc lamps, which light about 20 villages. In addition, current is supplied for 20,000 commercial lights and about 500 hp in motors.

The Staten Island Electric Railroad Company, which is owned by the above company, owns 30 miles of single and double-track, 26 cars being operated in winter and 70 cars during the summer months. The railway runs along the entire north shore of the island, and along the south shore to South Beach. The Southfield Beach Railroad Company, also closely allied with the above interests, has just completed a line, on which aluminum wire was employed for feeders, from South Beach to Midland Beach. The rolling stock of both roads consists of Brill cars, with Peckham trucks and G. E. motor equipments. These roads are supplied with current by the New York & Staten Island Electric Company.

HISTORY OF THE CONSOLIDATION.

The electric lighting industry on the island started during Erastus Wiman's time, about 12 years ago, when a plant was located at St. George. It was at this time also that the Staten Island Rapid Transit Railroad Company was formed to operate a ferry and steam railroad along the shores of the island. The railroad at that time ran eight passenger cars filled most of the time, but now that electric railway has absorbed a great portion of their business, but three cars constitute a train. It was at the St. George plant, it is claimed, that the first high-pressure boiler ever put in actual practice in this country was erected. It was of 600-hp capacity, carrying a pressure of 250 lbs., and was located in the open air without any covering.

About the year 1890 Mr. Wiman attempted to consolidate all of the electrical industries on the island, and erected a large plant at Livingston, but before its completion he failed, and the plant lay idle for several years with just the side walls of the building standing. The boilers had been placed, but were removed.

The old St. George plant was equipped with seven engines of different makes, Ft. Wayne and Westinghouse single-phase alternators, and American Wood & Brush arc machines. From this old plant

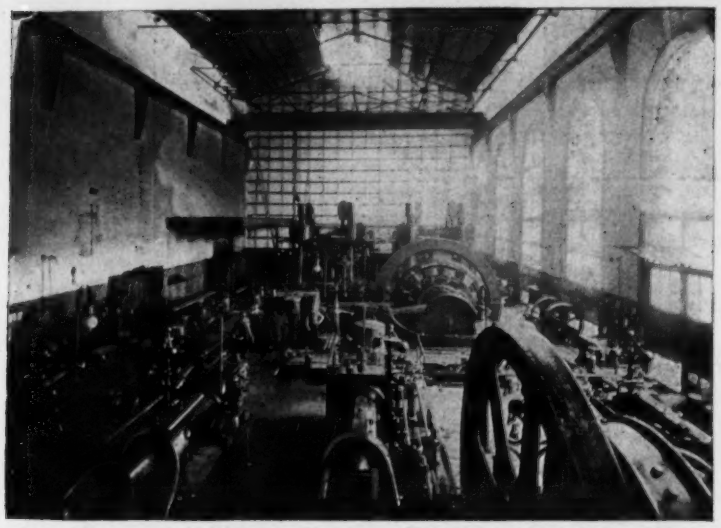


FIG. 2.—OLD STATION AT LIVINGSTON.

some 10,000 incandescent and 150 arc lamps were supplied with current. The electric railway first made its appearance at about that time with a power house at New Brighton having an equipment of two Allis engines and two General Electric generators of 500 kw capacity. This plant was built by Sheaff & Jaastad, and it is claimed that its efficiency has not been surpassed by any plant up to date.

It was then that the New York & Staten Island Electric Company was formed to complete the Livingston plant. It absorbed the street railway and moved that plant, also the St. George and several minor plants to Livingston. This plant was never completed in a satisfactory manner, owing to the fact that the St. George plant was burned to the ground Aug. 3, 1891, and apparatus had to be installed in any manner possible. The St. George plant was rebuilt temporarily, but is now torn down. The Port Richmond and the New Brighton plants are also entirely abandoned, and the latter is now used by Mr. McLeod, the contractor for steam fitting for the Metropolitan and Manhattan roads.

THE CONDITION OF THE OVERHEAD SYSTEM.

The overhead construction, as is usually the case when a number of companies consolidate, was a very bad mess, and owing to the fact that each plant employed different voltages and different periodicity of alternations it was a very difficult problem to straighten the matter out. The entire system had to be changed from single-phase to two-phase, and brought down to a universal period of 60 cycles. The accompanying map (Fig. 1) clearly shows the amount of territory covered by the lines of the company. The very heavy black lines indicate the route of the railway, and the single heavy black lines indicate the primary lighting circuits of the company. It must be understood that miles and miles of wire are strung simply to feed a few series and incandescent street lamps. These lamps are run in series of 10 and 20, as circumstances permit, both 50 and 110-volt lamps being used. The power factor of the system is necessarily extremely poor, owing to the fact that a great many small transformers and shunt coils are in operation on the system. It is practically an impossibility to lay out centers of distribution and run feeders to them. Hence the method adopted is a system of local "static" boosters located on poles in various parts of the island and feeding small isolated territories. These boosters are ordinary small transformers connected into the line in such a manner as to raise or lower the voltage a given percentage, which varies from 5 to 20.

THE LIVINGSTON PLANT BEFORE RECONSTRUCTION.

Judging from the great variety of machinery which was housed in the Livingston station before its reconstruction one might almost have called it a Pan-American for high-grade machinery manufactured during the past decade. The original equipment consisted of two 250-kw General Electric railway generators driven by Allis engines, one 1000-kw Walker-Allis combination and two triple-expansion vertical McIntosh & Seymour engines, direct connected to 300-kw, two-phase Stanley alternators. Four years ago there were added two McIntosh & Seymour engines direct connected to two 300-kw Stanley two-phase generators, Onondaga exciters direct connected to Harrisburg engines, and three 160-light Brush arc machines belted to tandem Ball & Wood engines. In the boiler room there were ten Babcock & Wilcox 350-hp boilers, four of which were removed from the New Brighton plant. The arc lighting and railway switchboard panels were built by the General Electric Company, and the incandescent board by the Stanley Electric Manufacturing Company .

The installation of the additional machinery a few years ago was necessitated by the large increased demand for current. The company at that time decided upon some radical changes, one of which was the elimination of their open-arc system and substituting in its place a constant-current transformer system. South Beach and Tottenville are the two localities which were originally equipped with this system, nearly three years ago, and it proved so entirely satisfactory that the company is at present changing its entire arc system to the system above referred to. The advantage of this system is clearly shown in the lighting of the village of Tottenville, 17 miles from the power house, where a system of tub transformers is located and operated from the Livingston plant. The drop in pressure between the power house and Tottenville is 350 volts on a primary line of 2400 volts; and still, with this great drop, the constant-current

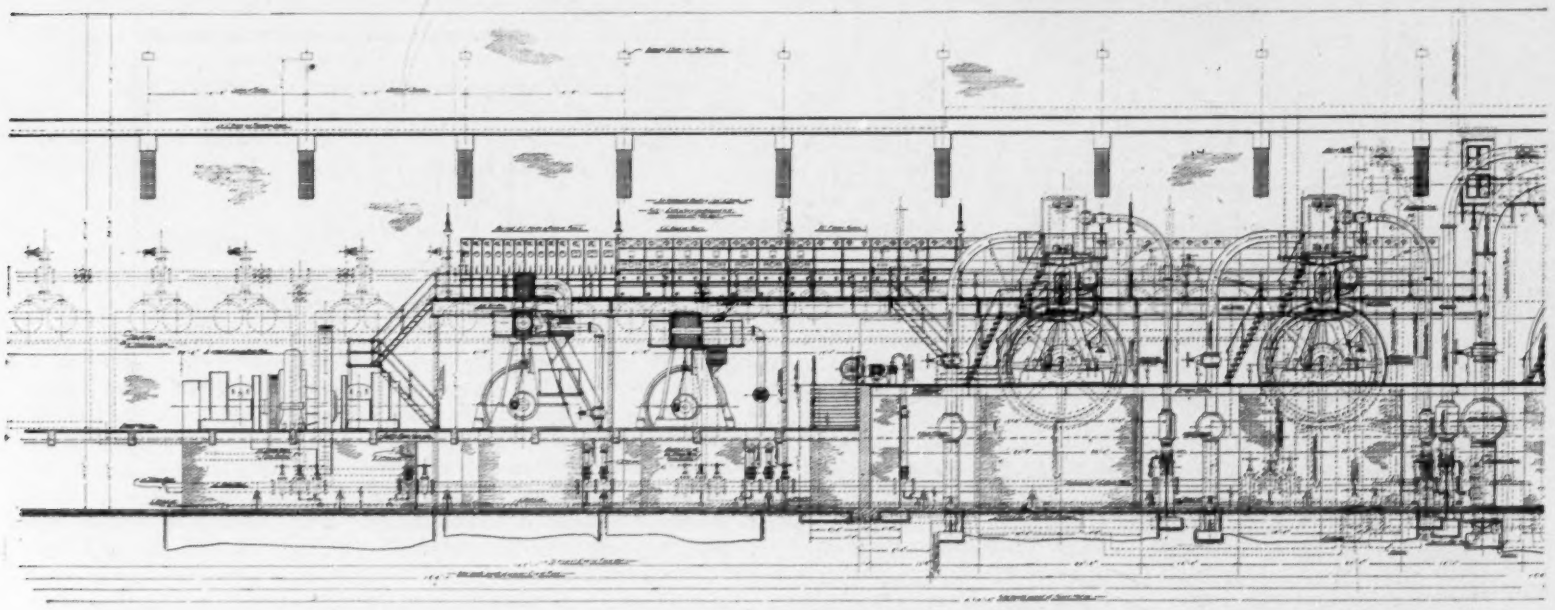


FIG. 3.—LONGITUDINAL SECTION OF POWER HOUSE AT LIVINGSTON.

series alternating-current arc system has worked satisfactorily. South Beach also received a tub transformer equipment, which is operated from the Livingston power house. In changing over the other circuits, all the transformers will in the future be located in the power house instead of being placed in the line. The reason for locating the transformers at Tottenville and South Beach is that commercial circuits and street lighting circuits are taken off the main feed lines between these points and the power house. It is evident under these conditions that the same feed lines from the power house feed and operate arc lamps at the terminal of the line and incandescent lamps between the power house and the transformer station.

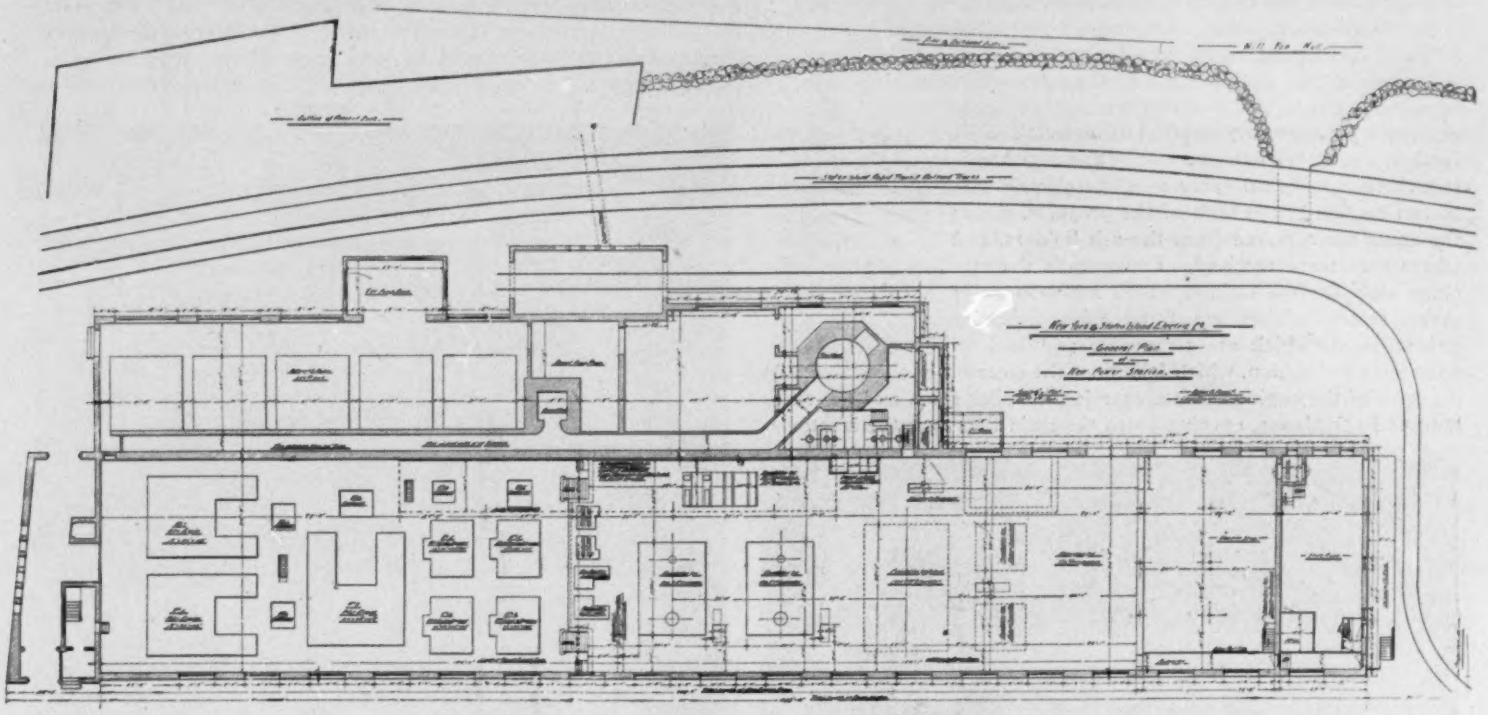


FIG. 4.—GENERAL PLAN OF NEW POWER HOUSE.

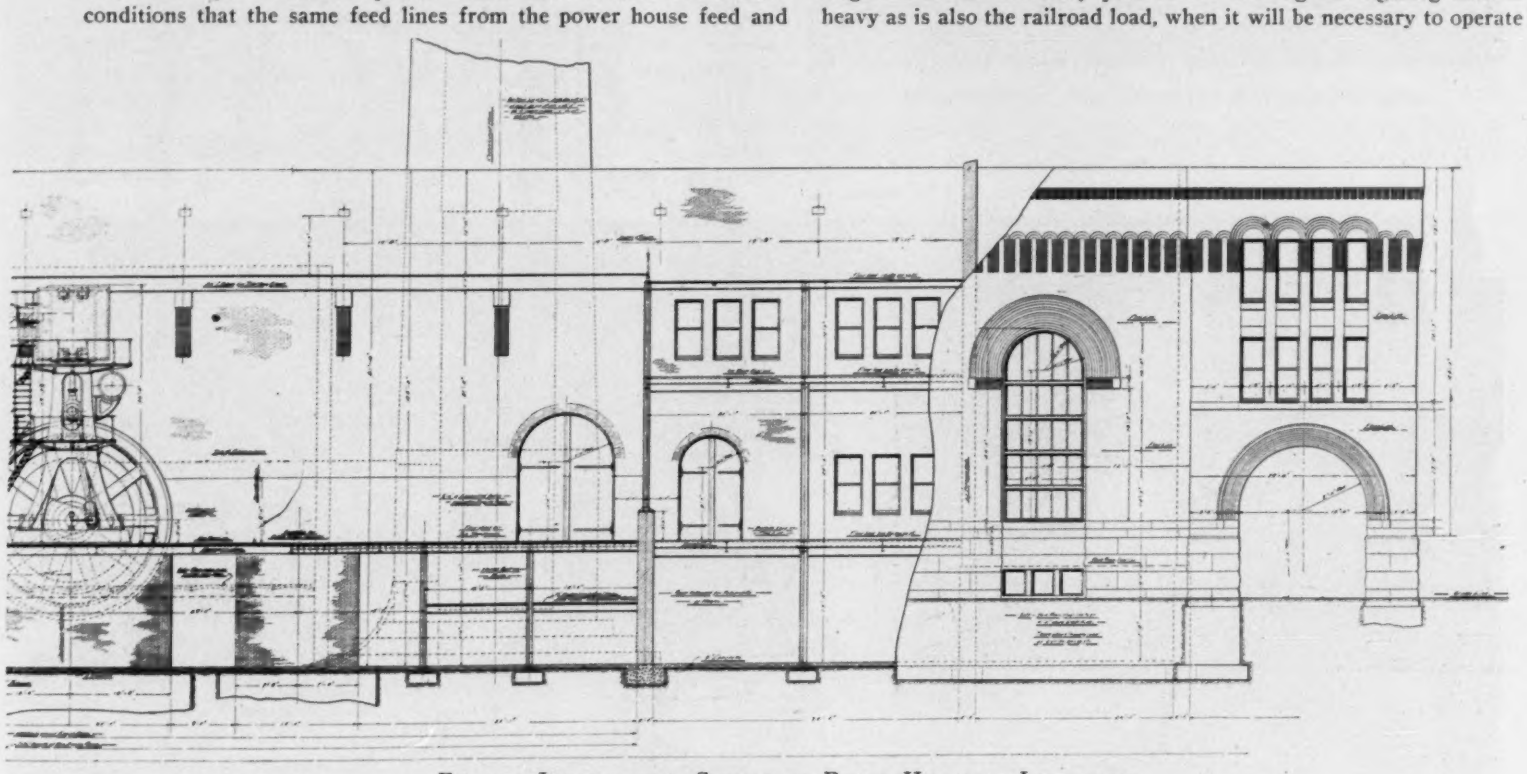


FIG. 3a.—LONGITUDINAL SECTION OF POWER HOUSE AT LIVINGSTON.

THE RECONSTRUCTED LIVINGSTON PLANT.

It was soon found that the station equipment was inadequate to meet the growing demand of the company's customers, and hence it was decided last year to greatly enlarge the plant at Livingston. Some radical departures from common practice were decided upon, and Mr. A. B. Proal, Jr., the chief engineer of the company, to whom this task was entrusted, feels confident that when the new plant is completed it will efficiently meet the extraordinary conditions existing on the island.

It is contemplated that in the near future the railway will be operated by the use of rotary transformers, and the general plan, which is now under consideration, is as follows: During the day the lighting and railway loads being very small, the company expect to operate a rotary transformer from the lighting engines, thereby using large units. In the early part of the evening the lighting load is heavy as is also the railroad load, when it will be necessary to operate both the lighting engines and railroad engines. Again, later in the evening both drop off very rapidly, when the operation can be reversed and the railroad machines can operate the lighting, or vice versa.

The building, which runs parallel with the water front, being separated therefrom by the tracks of the steam railroad is 434 ft. 6 inches in length, 63 ft. 6 inches high and 70 ft. 6 inches in width. It is constructed of Hurricane Island granite and pressed brick. At the western end are the executive offices and the chief engineer's and draughting rooms. Adjoining these is the old plant, shown in Fig. 2, with

the switchboard running transversely across the building. The new portion of the building adjoins this, and the 130-ft. switchboard, which runs along the northern wall, extends partly into the old plant. At the far end of the plant is the machine shop, the arc lamp repair department and the carpenter shop, beyond which is the storeroom, which is three stories high and of fireproof construction, entirely isolated by fire-brick partitions. This portion of the building is equipped with electric elevators and with all conveniences for the handy disposal of material. Still further, and at the extreme end of the new building, there is sufficient space to allow electric cars to run around to the back of the property, where the ashes are removed from the ash holders, and where stores are received. Underneath the machine shop are the stables, which are modern in every respect. They are fitted with Schrader patent floors, which are removable and laid on a concrete foundation, which facilitates the cleaning of the stable. At the back of the engine room proper is the boiler room and the stack house. In the latter, opening on to the main floor, are the lavatories

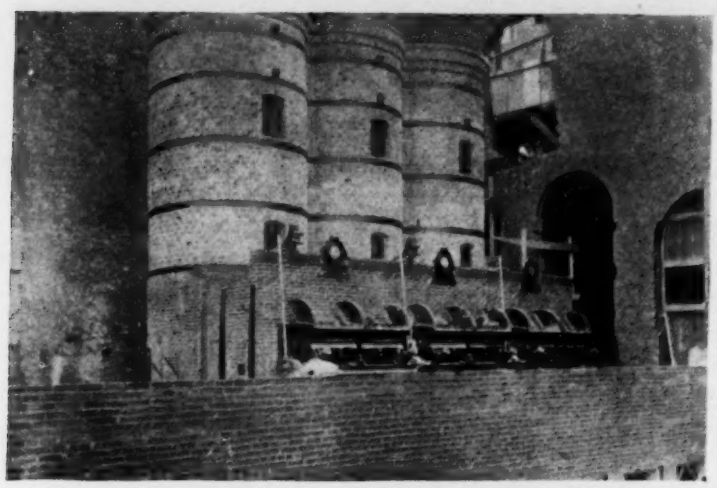


FIG. 6.—WICKES BOILERS INSTALLED AT LIVINGSTON.

for the employes, and on the second floor of the stack house are the bathrooms. Still above these are the locker rooms for all employes. A 20-ton traveling crane, built by the Union Iron Works, spans the building and runs along its entire length. A longitudinal section of the station, as it will appear when it is completed, is shown in Fig. 3.

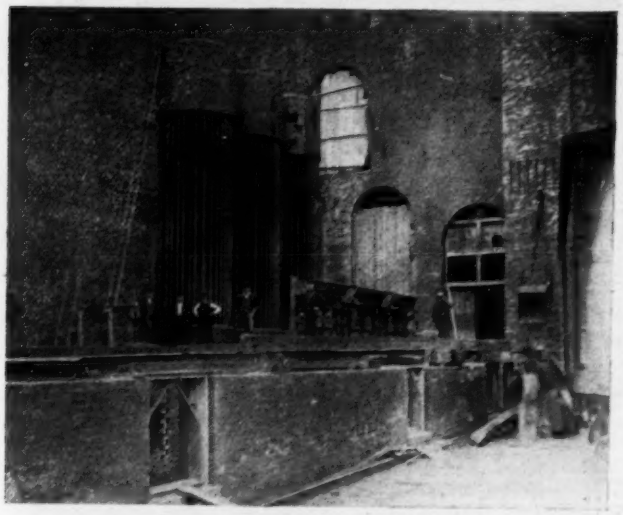


FIG. 7.—WICKES BOILERS, WITH BRICK COVERING REMOVED.

In Fig. 5 is shown a transverse section, while Fig. 4 shows the general layout of the various machines and the location of the station.

In the spacious engine room, the floor of which consists of concrete, upon which 2-inch spruce boards and then 1-inch narrow maple boards are laid, there are now being installed upon extra heavy concrete foundations, two vertical cross-compound Allis engines direct connected to two 500-kw Westinghouse rotating armature, two-phase, 60-cycle, 2400-volt alternators. These units are connected to a

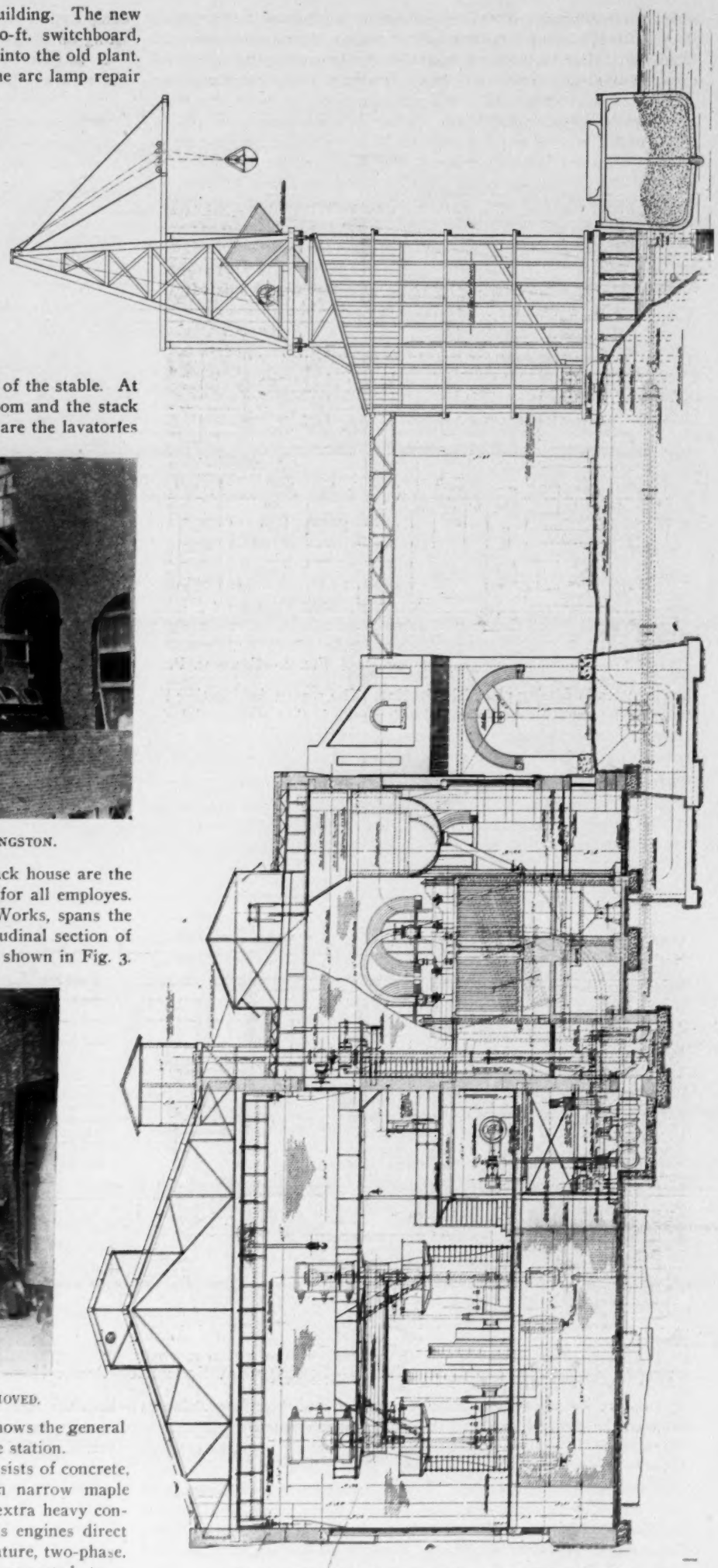


FIG. 5.—TRANSVERSE SECTION OF NEW POWER HOUSE.

Worthington central condensing system. This system is operated with centrifugal pumps, made by the Lawrence Machine Company, of Lawrence, Mass., and driven by Buffalo Forge Co.'s vertical direct-connected engines. They are also arranged so that they may be driven electrically by motors. The general scheme provides for the future installation of considerable additional machinery.

The new boiler equipment consists of three 333-hp Wickes Brothers vertical water-tube boilers, equipped with Acme mechanical stokers.

FIG. 8.—MUD DRUMS ATTACHED TO BOILERS IN POWER HOUSE.

There is also room for three more boilers of the same type. These boilers, shown in Figs. 6 and 7, carrying a pressure of 150 lbs., were especially built for this plant with extra large mud drums, which are shown in Fig. 8.

Foundations have been built for a new stack, which will be constructed as soon as the additional boilers are installed. The foundation is constructed of German pressed heavy radial brick, the inside diameter being 13 ft. The brickwork around the boilers from the floor line is also made of hollow brick made by Augustus Weber Sons, of Weber, N. J.

In the pump room are four compound duplex pumps, which are used for boiler feed and for injection purposes. The company has driven several artesian wells, and the water from them will be pumped by means of compressed air into a 35,000-gallon tank. This will tide over any possible break in the city water supply pipes.

The coal-handling apparatus is being built by the Robins Conveying Belt Company, and will take coal from boats with a one-ton steam shovel and deliver it in a 2000-ton coal pocket, from which it is taken by means of belts and distributed in the coal hoppers over the boilers. The ashes are removed by steel dumping cars from under the boilers, hoisted up by means of an elevator and dumped directly into the cars.

The new switchboard, when completed, will occupy a space along the length of the building, and will be 130 ft. long, the railroad panels being close to the railroad machines, then the rotary panels, machine panels, equalizing panels, then the circuit panels, and finally the house panels.

A NOVEL SWITCHBOARD SIGNAL SYSTEM.

As great difficulty was experienced in connecting the machines in parallel, owing to the large variations of speed of the different engines, some varying as much as 20 per cent from their normal speed, a system of signals was adopted which materially helped both the switchboard operator and engineers. This device, shown in Fig. 9, consists of a box frame with glass panels in the front, on which letters and numbers are outlined, the main body of the glass being painted black. Enclosed in each small box-like partition is an incandescent lamp which is connected to a keyboard, and is handled there by the operator. A street railway foot gong is used to signal to the engineer and attract his attention to the board. These signals are also used to call the attention of the various employes to the switchboard, as the local telephone service of the company is operated from the main board, and it is often found convenient to call some employe directly to the telephone switchboard. The company operates 40 telephone stations on the island, from which the inspectors report directly to the switchboard.

The officers of this enterprising company are General Samuel Thomas, president; J. H. Swinarton, vice-president and treasurer, and president of the allied railway companies on the island, and H. M. Work, secretary. Those in immediate charge of the power house and local business are Fred K. Lewis, superintendent; A. B. Proal, Jr., chief engineer; Edward S. Cliff, line superintendent; E. S. Terhune, electrical engineer, and George Fox, mechanical engineer. Fifty men are employed in the power house, besides eight machinists, as most repairs to machinery are made in the well-equipped machine shop.

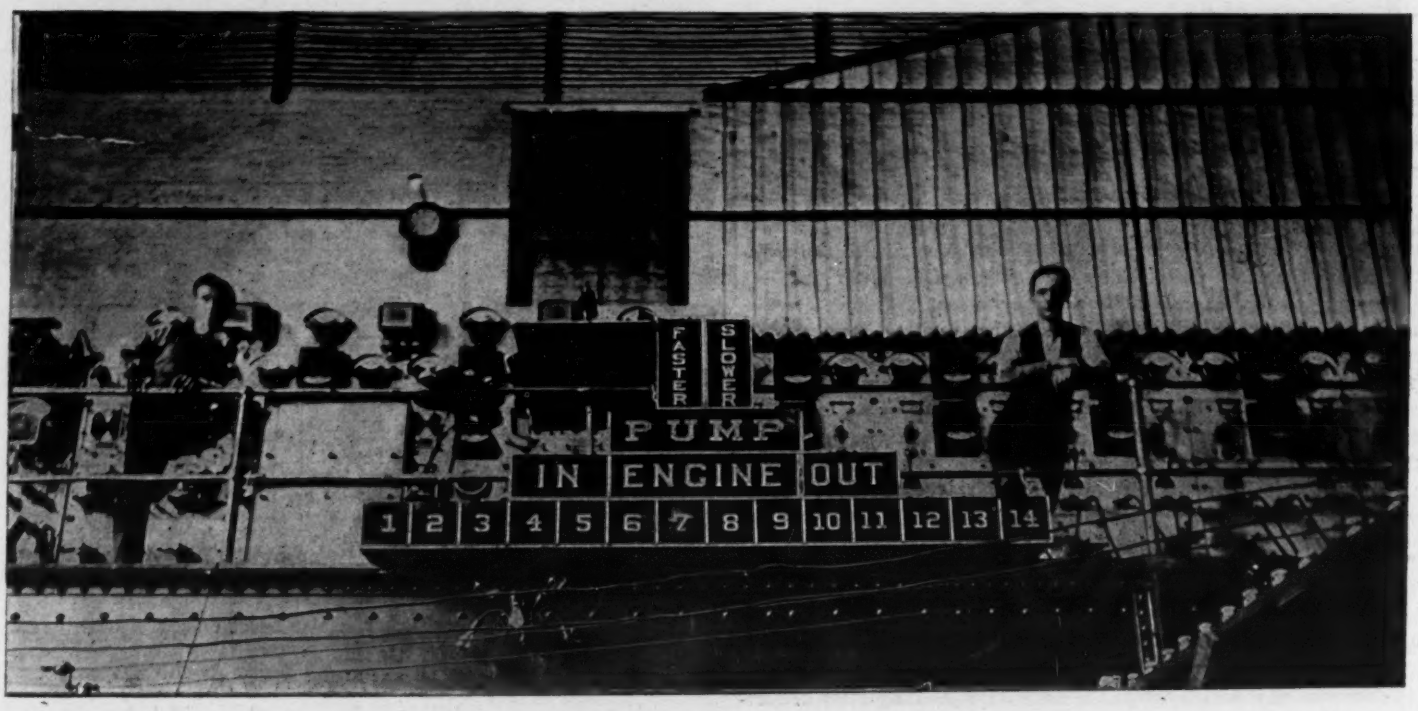


FIG. 9.—SIGNALING DEVICE IN USE IN POWER HOUSE.

The company, in its desire to keep abreast with the growth of the island and give to its customers uninterrupted service as well as the benefit of the latest development in engineering practice, contemplated the above improvements, now being completed, over a year

ago. Owing to strikes, fires and floods, however, the various contractors were unable to carry out their contracts, which caused the work to be unavoidably delayed for six months. Now that the installation on which $275,000 will have been expended, is nearly completed, the company is in a position to give the very best service to its customers and keep pace with present and future developments on the island as well as in the electrical arts.

Alternators with Dampers.

BY J. FISCHER-HINNEN.

UP to the present time very insufficient data have been published in regard to machines with dampers (amortisseurs). Most articles limit themselves to a superficial description of this system, and an enumeration of the various advantages which are claimed for the system. It might, therefore, be of interest to mathematically determine the influence of the damper on the operation of the machine, based on actual experiments with machines of this type.

The damper, in the form originally described by Leblanc, consists of a sort of short circuit ring, with which the magnet poles are provided. For this purpose the latter contain slots or holes parallel to the direction of the armature wires, as shown in Fig. 1, into which the

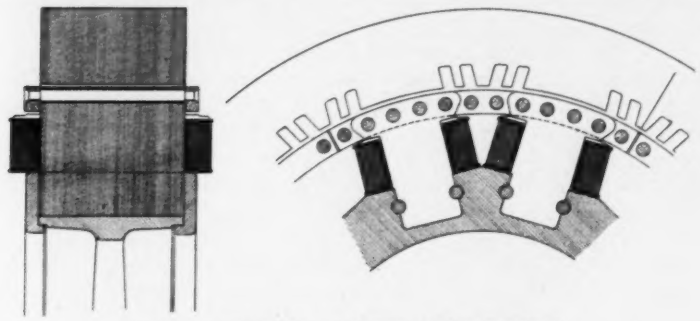


FIG. 1.—SHOWING DAMPING ARRANGEMENT.

insulated copper bars are buried. The insulation is only used for the purpose to insure a close fit and prevent rattling, and if it were not for this it would not have to be used. At the two ends the bars are interconnected by rings of copper or bronze. Such damper possesses the following properties:

1. The drop of pressure of the machine is reduced by choking a part of the armature reaction.

2. The machine is made more stable for paralleling.

Careful observations show that both advantages cannot be obtained at the same time in a machine. In the case of single-phase alternators, for example, only the first advantage is completely realized, while the damper in reality acts rather unfavorably on the synchronism, necessitating, as is the case with single-phase alternating-current motors, the employment of outside energy for synchronizing the rotor. Conversely, however, when using more than one phase, a rotary field is produced, which rotates synchronously with the magnets and has therefore no effect on the damper. The latter only begins to act when the machine for some reason, gets out of synchronism and has the effect of bringing the machine back to synchronism.

The action of the damper is therefore identical with that of the secondary winding of an asynchronous motor. The calculation is, therefore, made in a very similar way. Let us briefly review these formulæ so far as they enter into the discussion of the damper, and on account of its simplicity, we will consider the theory of polyphase motors.

GENERAL THEORY OF POLYPHASE MOTORS.

The well-known diagram for such motors is shown in Fig. 2. In this diagram

$\nu_1 \Phi_1$ represents the rotary field produced by the primary ampere-windings.

Φ_1 that part of it which enters the secondary winding after deducting the stray lines.

$\nu_2 \Phi_2$ the rotary field produced by the secondary winding, of the same phase as the secondary current.

Φ_2 that part of it which enters the primary winding.

Φ_a and Φ_m the resultant fields.

A little thought shows us that the secondary current I_2 has the same phase as the resultant pressure E_2, and in consequence follows ϕ_2 by 90 degs. The resultant pressure E_2 must not be confounded with the induced e. m. f., which has the direction $a\,c$ and is in advance of the former by the angle ϕ_2.

Furthermore:

E is the effective pressure of one phase (in the case of the delta connection the same as the terminal pressure, and for the star connection it equals the terminal pressure divided by $\sqrt{3}$).

I is the effective current, which flows through the wires.

m the number of phases.

n the revolutions per minute.

v the peripheral speed in m.

g the slip.

$100\,\varepsilon$ the ohmic loss (in per cent) in the primary winding.

$100\,\varepsilon_1$ the percentage loss in the iron.

$100\,\varepsilon$ the percentage loss due to friction.

$c = \frac{I}{T}$ the number of total periods.

p the number of poles (not pairs of poles).

$w_1 = 2\pi c$.

$w_2 = g w_1 = 2\pi c g$.

D the diameter of the rotor in cm.

l the length of the rotor in cm.

r a reduction factor for the cross section of air, in consequence of the slot openings and the paper insertions, approximately = 0.7 with open and 0.87 with closed slots.

N_1 and N_2 the total number of wires (not windings) on the periphery, primary and secondary.

q the number of circuits connected in parallel.

L_1 and L_2 the self-induction coefficients.

a the relation between the total magnetic resistance and the air resistance alone = 1.05 to 1.15 approximately.

δ the single air-gap in cm.

ν_1 and ν_2 the Hopkinson waste field coefficients.

The secondary phase distortion ϕ_2 is given by the formula

$$tang\ \phi_2 = \frac{g\,w_1\,L_2}{R_2} = x$$

As x is proportional to the —— slip, and is, therefore, one of the principal factors of the motor, we will hereafter represent all variables (current, torque, etc.) as functions of x and express the remaining goniometric functions of the angle ϕ_2 in tangents. To the actual magnitude of the term x we will return later.

For the sake of simplicity it is best not to consider the copper losses (a complete sub-division of the equation may be found in the author's paper on "The calculation of asynchronous alternating-current motors," in the *Zeitschrift fur Elektrotechnik*, Vienna, 1900, Nos. 29-33).

With these approximately correct assumptions in mind, the following simple formula may be deduced:

FIELD STRENGTH.

$$\Phi_m\ (\text{approx.}) = \frac{4\sqrt{2}\ .\ 10^8\ .\ m\,q\,E}{K_1\ .\ w_1\ .\ N_1} \qquad (1)$$

The values of K are given in the following table:

Number of teeth per pole and phase.	2 Phases.		3 Phases.		4 Phases.	5 Phases.	6 Phases.	Closed circuit ring.
	a	*b*	*a*	*b*				
1	2.00	..	2.00	..	2.00	2.00	2.00	2
2	1.85	..	1.93	..	1.96	1.98	1.98	2
3	1.82	..	1.92	..	1.954	1.97	1.98	2
4	1.81	2.77	1.91	1.66	1.952	1.97	1.98	2
∞	1.79	2.54	1.91	1.66	1.94	1.97	1.98	2

a represents winding with separate phases.
b represents winding with overlapping phases (similar to the drum winding of continuous current machines).

The number of lines of force can also be calculated from the ampere-turns. It is

$$\Phi = \sqrt{2}\ \frac{4\pi}{10}\ .\ \frac{I\,N}{p\,q}\ .\ \frac{D\pi l r}{p}\ \frac{k}{2\delta a}\ \nu \qquad (2)$$

According to whether the primary or secondary number of ampere-turns is substituted for $\frac{I\,N}{q}$, the primary or secondary rotary field will be the result.

The following Table II. gives values for the factor k:

TABLE II.

Number of teeth per pole and phase.	2 Phases.		3 Phases.		4 Phases	5 Phases.	6 Phases.	Closed circuit ring.
	a	b	a	b				
1	0.5	...	0.415	...	0.411	0.410	0.410	0.410
2	0.38	...	0.396	...	0.405	0.406	0.407	0.410
3	0.374	...	0.394	...	0.404	0.405	0.406	0.410
4	0.372	0.570	0.392	0.340	0.402	0.403	0.405	0.410
∞	0.368	0.520	0.392	0.340	0.400	0.402	0.405	0.410

(For meaning of a and b see Table I.)

From the equations (1) and (2) we obtain by proper elimination:

THE NO-LOAD CURRENT STRENGTH.

$$i_0 = \frac{E_1}{w_1\left(\frac{K_1 k_1 r}{2 \cdot 10^8} \cdot \frac{N_1^2}{m_1 q_1^2 p^2} \cdot \frac{D l}{\delta a} \cdot \nu_1\right)} = \frac{E_1}{w_1 L_1} \qquad (3)$$

PRIMARY CURRENT.

The primary e. m. f. — E_1 can be considered as the resultant of two e. m. f.'s, the primary self-induction $w_1 L_1 I_1$, which is proportional to the primary rotary field $\nu_1 \Phi_1$ and follows the same by 90 degs. and the so-called mutual induction e, which is caused by the secondary rotary field ϕ_2 and is, therefore, perpendicular to it.

According to Fig. 2:

$$\frac{e}{w_1 L_1 I_1} = \frac{\Phi_2}{\nu_1 \Phi_1} = \frac{1}{\nu_1 \nu_2} \cdot \frac{x}{\sqrt{1 + x^2}}$$

From the triangle $a\ b\ c$ we get:

$$E_1^2 = (w_1 L_1 I_1)^2 + e^2 - 2 (w_1 L_1 I_1)\, e \cdot \cos (90 - \phi_2)$$

Substituting the value of e we get

$$I_1 = \frac{E_1}{w_1 L_1} \sqrt{\frac{1 + x^2}{1 + x^2\left(1 - \frac{1}{\nu_1 \nu_2}\right)^2}} = i_0 \sqrt{\frac{1 + x^2}{1 + x^2\left(1 - \frac{1}{\nu_1 \nu_2}\right)^2}} \qquad (4)$$

For loads between no load and full load the expression $1 + x^2\left(1 - \frac{1}{\nu_1 \nu_2}\right)^2$ which in the future we will call A differs but little from unity. For small motors it is slightly higher, say, 1.15, for large motors somewhat smaller, say, 1.05. A mean value of 1.1 may be safely assumed.

SECONDARY CURRENT.

According to Fig. 2:

$$\frac{\nu_2 \Phi_2}{\Phi_1} = \sin \phi_2 = \frac{x}{\sqrt{1 + x^2}}$$

and substituting for Φ_1 and Φ_2 the values found in equation (2) we get

$$I_2 = I_1 \frac{k_1 N_1 q_2}{k_2 N_2 q_1} \cdot \frac{x}{\nu_2 \sqrt{1 + x^2}}$$

or,

$$I_2 = i_0 \frac{k_1 N_1 q_2}{k_2 N_2 q_1} \cdot \frac{x}{\nu_2 \sqrt{A}} \qquad (5)$$

SECONDARY PRESSURE.

From the triangle $a\ e\ f$ and $a\ g\ d$ we get

$$\Phi_a = \Phi_m \cdot \frac{1}{\nu_1 \sqrt{A}} \qquad (6)$$

in which Φ_m may be taken from equation (1). Also from equation (1) we get

$$\Phi_a = \frac{4\sqrt{2} \cdot 10^8 \cdot m_2 q_2}{K_2 g w_1 N_2} \cdot E_2$$

or,

$$E_2 = g E_1 \frac{N_2 K_2 m_1 q_1}{N_1 K_1 m_2 q_2} \cdot \frac{1}{\nu_2 \sqrt{A}} \qquad (7)$$

POWER FACTOR.

$$\cos \phi = \frac{e \cos \phi_2}{E_1} = \frac{w_1 L_1 I_1}{E_1 \nu_1 \nu_2} \cdot \frac{x}{\sqrt{1 + x^2}} \cdot \frac{1}{\sqrt{1 + x^2}}$$

$$\cos \phi = \frac{I_1}{i_0} \cdot \frac{x}{\nu_1 \nu_2 (1 + x^2)} = \frac{1}{\nu_1 \nu_2} \sqrt{\frac{x^2}{1 + x^2} \cdot \frac{1}{A}}$$

We must not lose sight of the fact that up to now we have not taken the iron and copper losses into account. This omission is permissible as long as we only consider the currents, pressures and lines of force where a few per cents do not make any material difference. But in determining the cos ϕ this omission would cause a grave error.

If

100 ε is the ohmic loss in the primary winding in per cent,

100 ε_1, the hysteresis and foucoult current losses in per cent,

then more accurately

$$\cos \phi = \frac{1}{(1 - \varepsilon)(1 - \varepsilon_1)} \cdot \frac{1}{\nu_1 \nu_2} \sqrt{\frac{1 + x^2}{x^2} \cdot \frac{1}{A}} \qquad (8)$$

TORQUE.

The torque is equal to the useful work divided by the speed; that is,

$$\text{Torque } Z = \frac{m \cdot I_1 E_1 (1 - \varepsilon)(1 - \varepsilon_1)(1 - g)(1 - z) \cos \phi}{9.81\ \nu}$$

or substituting the values of I and cos ϕ found in equations (4) and (8), we get

$$Z = \frac{m E_1 i_0}{9.81} \cdot \frac{60 \cdot 100}{D \pi n} \cdot \frac{(1 - g)(1 - z)}{\nu_1 \nu_2} \cdot \frac{x}{A} \qquad (9)$$

It is interesting to determine for what value of x the torque is a maximum. If we assume that there is no change in the value of

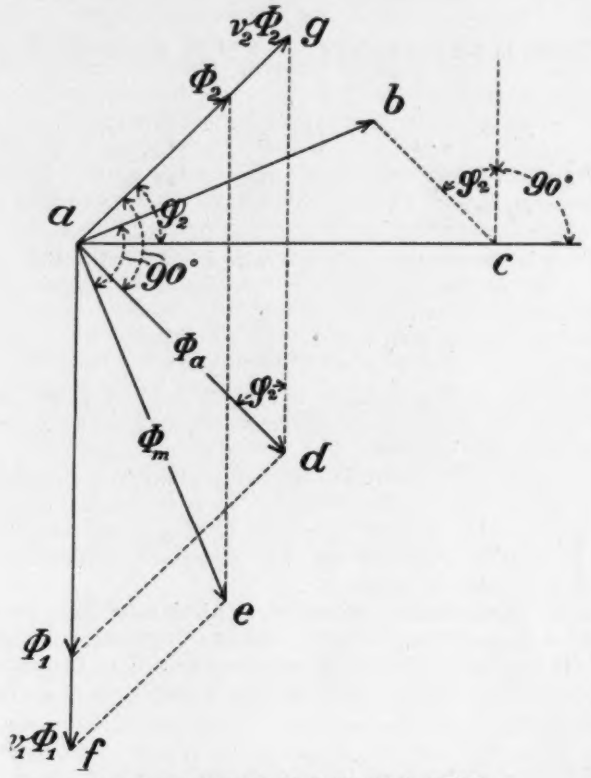


FIG. 2.—DIAGRAM OF POLYPHASE MOTOR.

$(1 - g)$ and $\nu_1 \nu_2$ then the only variable in the above equation is the quotient:

$$\frac{x}{A} = \frac{x}{1 + x^2\left(1 - \frac{1}{\nu_1 \nu_2}\right)^2}$$

which is a maximum when $x = \frac{1}{1 - \frac{1}{\nu_1 \nu_2}}$

Therefore,

$$Z\ (max.) = \frac{m E_1 i_0}{9.81} \cdot \frac{60 \cdot 100}{D \pi n} \cdot \frac{(1 - g)(1 - z)}{2\left(1 - \frac{1}{\nu_1 \nu_2}\right)} \qquad (10)$$

In reality Z (*max.*) is smaller, because the slip increases with the load. On the other hand the stray lines are generally reduced, so that the error is somewhat equalized.

Remark.—The above equations will serve completely for the determination of the dimensions and the winding of a polyphase motor for a definite output and a given *cos* φ. The operation will be about as follows: After the efficiency, i. e., the division of losses of the various parts has been decided upon and suitable values have been as-

sumed for the waste field coefficients, the value of x is obtained by means of equation (8) and by deciding on a definite peripheral speed, the no-load current is obtained from equation (9). The calculation may be simplified by eliminating the peripheral speed entirely. For this purpose both sides of equation (9) are multiplied by $9.81 \times v$ and divided by $m E_1$, then the useful current will be

$$I = i_0 (1 - g)(1 - z) \frac{x}{\nu_1 \nu_2 A} \qquad (11)$$

The external dimensions of the rotor, as well as the primary winding, is obtained from equation (3). The result is quickly obtained when one introduces the so-called current density (number wires $\times$ current strength). This term grows almost in proportion to the square of the diameter D, so that

$$\frac{I N_1}{q_1} = \beta D^2$$

in which β, according to the size of the motor, lies between the limits of $5-8$ for low pressures and $4-5$ for higher pressures.

If D and Z have been determined in the manner described, the calculation of the iron dimensions follows, and equations (1) and (6) are made use of.

There only remains now the secondary winding, for the calculation of which we make use of the term x.

Substituting in the expression $x = \frac{g w_1 L_2}{R_2}$ the values of L_2 and R_2, that is,

$$L_2 = \frac{K_2 k_2 r}{2 \cdot 10^8} \cdot \frac{N_2^2}{m_2 q_2 p^2} \cdot \frac{D l}{\delta a} \cdot \nu_2$$

and

$$R_2 = \frac{2}{10^8} \cdot \frac{N_2 \lambda}{s_2 m_2 q_2}$$

in which λ is the length of a single wire in cm. and s_2 the cross-section in sq. cm., then by a slight transformation we obtain

$$N_2 s_2 = 63 \cdot x \frac{\delta a p^2 \lambda}{g c K_2 k_2 r D l \nu_2} \qquad (12)$$

The left side of this equation is nothing more than the cross-section of all the wires of the secondary winding, while the right sides contains only quantities with which we are acquainted. The connection of the wires, as we will see, has no effect on the value of x, so far as the product number of wires $\times$ cross-section is not altered, but it is self-evident that the secondary current is dependant on it (compare equation 5), which has to be taken into consideration in machines with collector rings.

In the case of short circuit armatures, to which the damper belongs, the method of calculating is slightly different. Especially the derivation of the resistance R_2 is a trifle more complex. Only the resultant equations are given below. The complete derivation is given in the paper cited above.

If we call

l^1 the distance between the two lateral rings in cm.

s_2 the cross-section of the wires on the periphery in sq. cm., and

s^1_2 the cross-section of the lateral rings, then

$$R_2 = \frac{8}{10^8 p} \left(\frac{l^1}{s_2} + \frac{0.63 D N_2}{p^2 s^1_2} \right)$$

and according to equation (3), in which we can call

$$q_2 = \frac{p}{2} \text{ and } m_2 = \frac{N_2}{p}$$

$$g w_1 L_2 = 2 \pi c g \left(\frac{1.62 r}{10^8} \frac{N_2 D l \nu_2}{p^2 \delta a} \right)$$

and by division

$$x = \frac{g}{80} \frac{N_2 s_2 r D l c \nu_2}{\delta a \left(l^1 p^2 + 0.63 D N_2 \frac{s_2}{s^1_2} \right)} \qquad (13)$$

This equation may be written

$$N_2 s_2 = 80 \delta a \frac{\left(p^2 l^1 + 0.63 D N_2 \frac{s_2}{s^1_2} \right)}{c g r D l \nu_2} \cdot x \qquad (14)$$

The value of $\frac{s_2}{s^1_2}$ is assumed at the start, as is also the number of wires, and the calculation will give no further difficulty.

APPLICATION TO POLYPHASE GENERATORS WITH DAMPERS.

Having now presented the fundamental equations which, while quite numerous, are very essential for the better understanding of what follows, we will consider the machines with which this paper deals.

It is clear that the above formulæ can only be employed in the calculation of alternating-current generators with certain reservations, as the chief condition, a constant self-induction coefficient, is missing. While the calculation will on this account not be very accurate, it is further aggravated by the coefficients ν_1 and ν_2 which can only be approximated. The following data will serve rather the purpose of giving an approximate idea of the method of operation of a damper than to give definite figures.

The problem is to investigate the influence which a damper has on a flywheel machine, which has a variable speed on account of the unfavorable positions of the crank. For this purpose let us use equation (9) for the torque.

For E_1 we cannot take the line pressure E, but only half the resultant of the e. m. f.'s E_2 of the two machines (see Fig. 3). That is,

$$E_1 = E_2 \sin \frac{a}{2}$$

Usually the angle a is very small, so that the sine can be replaced by the arc. In this case

$$E_1 = E_2 \frac{a}{2} \qquad (15)$$

and, therefore,

$$i_0 = \frac{E_1}{w_1 L_1} = \frac{E_2}{w_1 L_1} \cdot \frac{a}{2} \qquad (16)$$

The maximum phase angle a can be determined in the following manner: In the case of a single cylinder engine there is an energy

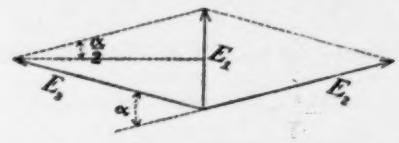


FIG. 3.—RESOLUTION OF E. M. FS.

equalization between steam engine and flywheel four times during each revolution. During each revolution the flywheel traverses an arc πp, in consequence of which the greatest advance or retardation of one machine with respect to the other for the most unfavorable crank position and a degree of uniformity u, is

$$a = \frac{1}{4} \frac{\pi p}{u} \qquad (17)$$

In the case of two-cylinder machines there is an energy exchange eight times during each revolution. The maximum variation is, therefore,

$$a = \frac{1}{8} \frac{\pi p}{u} \qquad (18)$$

The secondary angular velocity w_2 is finally obtained from the primary w_1, the factor u and the simple equation

$$g = \frac{1}{u} \text{ as follows:}$$

$$w_2 = g w_1 = \frac{2 \pi c}{u} \qquad (19)$$

We are now acquainted with every member of equation (9), and we can now calculate the torque Z, or, by multiplying both sides by the speed v, the output in kg. m. seconds. At present we are concerned with a comparison between the work of the flywheel and that of the damper. In consequence of this, we need not consider the output per second, but only the work P_3, which is done by the damper during the time, in which the flywheel delivers energy to the steam engine or accumulates energy.

This time, in the case of a single-cylinder engine amounts to $\frac{60}{4n}$ and for a double-cylinder engine $\frac{60}{8n}$ seconds.

Hence:

$$P_1 = Z v \frac{15}{n} \text{ for the single-cylinder engine.} \qquad (20)$$

and

$$P_1 = Z v \frac{7.5}{n} \text{ for the double-cylinder engine.} \qquad (21)$$

The work of the flywheel P_2 is represented by the well-known equation,

$$P_2 = \frac{G}{9.81} \cdot \frac{v^2}{u} \qquad (22)$$

in which G is the weight of the revolving masses and v the velocity at the central point of the revolving masses.

Example.—It is interesting to determine the values of P_1 and P_2 for an existing 350-hp, two-phase flywheel machine. The machine was coupled to a single-cylinder steam engine. The data for this machine are as follows:

Terminal voltage $E = 88$ volts.
E. M. F. E_2 (for $\cos \phi = 0.9$) $= 120$ volts.
Current strength per phase $I = 1420$ amperes.
Revolutions $n = 65$
Number of periods $c = 39$
Number of poles $p = 72$
Diameter $D = 530$ cm.
Width $l = l^1 = 21$ cm.
Air-gap $\delta = 0.7$ cm.
Number of bars $N_2 = 432$
$s_2 = 5.21$ sq. cm.
$s^1_2 = 20$ sq. cm.
$r = 0.8$
$a = 1.1$
$v_1 = v_2 = 1.2$
$w_1 L_1$ (from test) $= 0.059$
$G = 23{,}200$ kg.

$$v = 4.4 \pi \frac{65}{60} = 15 \text{ m.}$$

$u = 115$

From which

$$a = \frac{1}{4} \frac{\pi p}{u} = \frac{\pi 72}{4 \times 115} = 0.49$$

$$E_1 = E_2 \frac{a}{2} = 120 \times \frac{0.49}{2} = 29.4 \text{ volts.}$$

$$i_0 = \frac{E_1}{w_1 L_1} = \frac{29.4}{0.059} = 500 \text{ amp.}$$

According to equation (13)

$$x = \frac{g}{80} \frac{N_2 s_2 r D c l v_2}{d a \left(l^1 p^2 + 0.63 D N_2 \frac{s_2}{s^1_2} \right)}$$

$$= \frac{432 \times 5.21 \times 0.8 \times 530 \times 39 \times 21 \times 1.2}{115 \times 80 \times 0.7 \times 1.1 \left(21 \times 72^2 + 0.63 \times 530 \times 432 \frac{5.21}{20} \right)} = 0.9$$

and finally by neglecting the slip and the friction resistance:

$$P_1 = Z v \frac{15}{n} = \frac{m E i_0}{9.81} \cdot \frac{x}{v_1 v_2 A} \cdot \frac{15}{n}$$

$$= \frac{2 \times 120 \times 500 \times 0.9 \times 15}{9.81 \times 1.2 \times 1.2 \times 1.1 \times 65} = 1600$$

$$P_2 = \frac{G v^2}{9.81 u} = \frac{23200}{9.81} \times \frac{152}{115} = 4630$$

These figures show that the damper actually influences to a certain degree the uniform running of the machine. This influence, however, is but slight under normal operating conditions, especially as the torque decreases with the third power of the constant u. Besides, this factor is of little account, except that it insures greater stability for paralleling the machines. If we shift the phases by 90 degs., which would ordinarily cause the machines to get out of step, we obtain the maximum torque and in addition an amount of work,

$$P_1 = 9000 \text{ kgm.}$$

in other words, twice as much as the flywheel itself furnishes. It must be kept in mind, however, that the equalizing current i_0 increases correspondingly up to about 1400 amperes, which is of no small account in considering the safety of operation.

A single-cylinder engine has been chosen in order to bring the influence of the damper out more clearly. The result would have been quite different if a compound engine had been selected. In this case the phases would have been shifted only one-half as much as in the first instance, the torque is reduced to ¼ and the quantity P_1 to ⅛ of the original values. There will be a further reduction on account of the increase of the factor u, the change varying as the third power of this factor. The ratio $\frac{P_1}{P_2}$ will also be considerably more unfavorable. The question now arises whether single-cylinder engines are not preferable in a number of cases to compound engines. This question, which seems almost superfluous in view of modern practice, is nevertheless justified when we consider installations principally used for lighting purposes. Such machines generally operate at full load for only a few hours and with no load the remainder of the day, as they only have to furnish the no-load current for the transformers.

Under such conditions a good single-cylinder engine is much more advantageous with respect to steam consumption than a compound engine, aside from the other advantages which it possesses for rapid regulation and paralleling. The answer may be made that during the day a smaller machine might be used, but frequently this method cannot be employed. I know of some cases where a large machine which was fully capable of carrying the night load, was not capable of furnishing the no-load current for the transformers during the day, because the drop pressure was too great, although the current was far below the normal.

Finally, I should like to point out a property of single-cylinder engines, which, in my opinion, has not received sufficient attention in the past, that is, their comparatively uniform operation. By this is not meant the so-called degree of uniformity, i. e., energy variations during each stroke, which variations are greater, of course, in the case of single-cylinder engines, than in the case of compound engines; the essential feature is the steadiness of the change from minimum to maximum speed. This is brought about by the single control and the small number of elements which are subjected to disturbances. If we consider now that the momentary value of the pressure depends directly on the speed, it will be easily seen that every irregularity in the operation of the steam engine has the effect of forming higher harmonic waves. Instead of seeking the causes of such phenomena in the alternator itself, it would frequently be advisable to subject the regularity of the steam engine to close investigation.

SINGLE-PHASE GENERATORS WITH DAMPERS.

In the case of single-phase generators the thing which interests us in the first place is the influence which the damper exerts on the drop of pressure of the machine. As we are only concerned at present with comparative figures, we can neglect the small ohmic resistance of the primary winding and consider the drop of pressure in the primary winding proportional to the field $v_1 \Phi_1$. The calculation will be considerably simplified, if we consider the field $v_1 \Phi_1$, which varies in strength, replaced by two rotating constant fields of half the strength which have the opposite direction from the angular velocity w_1. One of these fields revolves synchronously with the magnets, i. e., the damper, and has, therefore, no effect on the latter. The other rotary field moves opposite to that of the damper with a velocity $2 w_1$ in a backward direction, and produces therein currents of twice the number of periods. It is clear that under such conditions the quantity x, which has been explained above, will be very large, so that the angle ϕ_2 may practically be assumed as 90 degs.

Let us construct in the well-known manner the parallelogram of field intensities. For this purpose it is only necessary to replace the components Φ_1 and $v_1 \Phi_1$ in Fig. 2, by $\frac{\Phi_1}{2}$ and $\frac{v_1 \Phi_1}{2}$ Under the practically correct assumption that $\vartheta_2 = 90$ degs., the primary and secondary fields have opposite directions. From this it follows that

$$\Phi_m = \frac{v_1 \Phi_1}{2} - \Phi_2 = \frac{v_1 \Phi_1}{2} - \frac{\Phi_1}{2 v_2} = \frac{v_1 \Phi_1}{2} \left(1 - \frac{1}{v_1 v_2} \right)$$

The total self-induction of a machine with damper has therefore

the following relation to the self-induction of a machine without a damper,

$$\frac{\frac{\nu_1 \Phi_1}{2} + \frac{\nu_1 \Phi_1}{2}\left(1 - \frac{1}{\nu_1 \nu_2}\right)}{\nu_1 \Phi_1} = \left(1 - \frac{1}{2\ \nu_1 \nu_2}\right)$$

If it were possible to construct a machine without a stray field (i. e., $\nu_1 \nu_2 = 1$), then the original drop of pressure would be reduced to one-half by the damper. In reality, the stray field is quite large in consequence of the large air-gap. Even in the case of an ordinary induction motor with only a 1 mm. air-gap and nine teeth per pole, $\nu_1 \nu_2$ varies from 1.1 to 1.15. For the small number of teeth, usually employed, and an air-gap of from 5 to 7 mm., this value must be assumed much greater and can hardly be less than from 1.5 to 1.6. The greatest reduction of the drop of pressure which can be obtained, can therefore be, under the most favorable conditions, about 30 per cent, but may be considerably less. Decreasing the drop of pressure 30 per cent, however, means an increased output of the machine of 30 per cent. It must not be forgotten, however, that the damper requires considerable copper in its construction, and therefore adds considerable to the cost of the machine.

The following Table III., which presents data of machines which have been constructed, will more clearly demonstrate this contention:

TABLE III.—WEIGHT OF COPPER ON MACHINES WITH DAMPERS.

	Kilowatts.	40*	125*	350	600	1000
Weight of Copper.	Armature ..	50 kg.	150 kg.	1200 kg.	580 kg.	1800 kg.
	Field	115 kg.	320 kg.	1900 kg.	2140 kg.	3640 kg.
	Damper ...	114 kg.	200 kg.	1030 kg.	1650 kg.	1530 kg.

As will be seen, the average weight of copper on the damper is more than one-half of the weight of copper on the fields.

There is no doubt that the same purpose could have been achieved by slightly strengthening the magnetic field and the use of less copper, aside from the fact that this also has the effect of decreasing the weight of copper of the armature wires, presupposing the same drop of pressure. In going through the calculation of these five machines, for example, it is found that on an average of one-fifth of the weight of copper on the damper would have been sufficient to cause the same drop of pressure.

Summing up all of the above, it must be admitted that in some cases the employment of the damper possesses certain advantages, but these advantages are out of proportion to the enormous first cost. Furthermore, there is no doubt that the same purpose can be accomplished in a simpler and cheaper manner by a corresponding distribution of the winding.

Finally, the construction of the damper interferes materially with the simple exchangeability of magnet coils, which is an important factor. Best suited for this purpose is the so-called inductor type, to which I referred in another article (Electrical World and Engineer, Sept. 2, 1899).

Rotary Converters vs. Motor Generators.

An article presenting the motor-generator side of the rotary converter vs. motor-generator controversy appeared in our issue of Sept. 21, and later was reprinted in our London contemporary, the *Electrician*. In a recent issue of that journal, Mr. H. S. Meyer criticizes some of the data and statements contained in this article, as follows:

Firstly.—Machines of entirely different makes are compared. This hardly ever leads to satisfactory figures, unless all the points of design are most carefully studied, and the tests based on exactly similar methods.

Secondly.—In the case of motor-generator sets, the figures given are taken from curves obtained either by calculation or tests, while the figures for the rotary converter are values guaranteed by some other manufacturer.

From a German technical paper, where the same article appeared, we learn that the rotaries referred to were of American make, and as it is common practice in the States to allow in all guarantees concerning electrical constants of a machine a safe margin of at least ½ per cent to 1 per cent under the value obtained in actual test, the comparison should be corrected from this point of view. To illustrate this, I give in the following table figures taken from test reports of some standard 25 cycle rotary converters made by one of the large American firms of exactly the type chosen for the above comparison—i. e., a 250-kw and 500-kw three-phase converter, with necessary step-down transformer cooled by air blast.

	250-kw.				500-kw			
Efficiency.	Trans.	Rotaries.	Combined.	As given.	Trans.	Rotaries.	Combined.	As given.
Full	97.1	94.83	92.0	89.5	97.88	95.0	93.0	90.5
½	96.3	92.25	88.7	85.0	97.01	93.1	90.3	85.5
¼	93.1	86.55	80.6	....	94.75	88.2	83.5	....

If a new comparison is made on the basis of the above figures, it will show already a decided advantage on the side of the rotary converter; but it should further be borne in mind that the motor-generator sets seem to be built on special order, while the rotaries and transformers quoted are of standard make. It will be readily understood that a special machine may be built with much higher constants than it would be advisable to use for a standard line where cost and weight are the most important items. Incidentally, it might be mentioned that the values given in the table are not all in accordance with the curves. I mention as a case Fig. 4 of the 350-hp induction motor, where the curve indicates for full load, $\cos \phi = 0.79$, which apparently should read 0.89, while the table gives 0.91.

Thirdly.—The comparison of heating constants given in the article shows similar inconsistency, as here, again, values obtained on actual tests after full load run of 10 hours are compared with guaranteed limits which can only refer to tests of a much severer character corresponding to the standard American heating guarantees for this class of machine, and which read as follows: No part of the converter, as measured by thermometer after a run of 24 hours at rated load and unity power factor, will rise more than 35 degs. C. above that of the air surrounding the machine, provided the temperature of the air does not exceed 25 degs. C. With the load then increased to 50 per cent overload and unity power factor, no part of the converter will rise after a two hours' run at this load more than 55 degs. C. above that of the surrounding air.

This is further illustrated by the following table, which gives the heating values from the same test reports for the two sizes of rotaries, which compare very favorably with those given for the motor-generator sets:

	250-kw		500-kw.
	10 hours, full load.	50 per cent. overload, two hours.	10 hours, full load.
Arm. core by therm.....	20.7	24.8	31.5
Windings by res.	30.8	32.8	29.6
Commutator by therm.	29.9	49.6	34.6

Fourthly.—As to the weight, even the table of the Oerlikon test per kilowatt for the different combinations given is as follows: shows a considerable advantage for the rotary converter. The weight

	Lbs. per kw.
Induction motor-generator set	168
Synchronous motor-generator set	145
250 rotary converter and transformers	110
500 rotary converter and transformers	94

The costs, which are not considered at all in the article referred to, form about the strongest point in the comparison, which is shown by the following information, and which gives the cost of the different items under discussion. The cost per kilowatt will be approximately as follows:

Transformers cooled by air blast, 100-200 kw....	£1	10	0
Rotary converter, 25 cycles, 250-500-kw.....	2	0	0
Oil-cooled reactance coils for obtaining 10 per cent compounding by phase control, for plants of 300 kw.	0	6	0
Direct-current generators, 250-400 kw, running at about 375 r. p. m.	3	1	0
Synchronous motor, 50 cycles, running at about 375 r. p. m., 250-400 kw, wound for 6000 volts....	2	10	0
Three-phase induction motor, 50 cycles, running at about 370 r. p. m., 150-250 kw, wound for 6000 volts	3	2	0

The last two machines would be somewhat cheaper if wound for a low voltage, but then additional transformers would have to be used,

*I should like to call special attention to the two types of machines referred to, of which five have been in operation at Saumur, France, since the middle of 1897, because they are provided with a special form of armature slots, patented this year by a well-known firm, and shown in Fig. 1. At the time when I designed that machine, I did not believe for a moment that there was anything novel in this form of slot, which undoubtedly had been used by others for a long time, and I did not think of applying for a patent. That this was done by another party simply demonstrates the mania with which certain professional inventors attempt to monopolize every thought, no matter how natural, for themselves.

which would reduce the efficiency and increase the total cost of the system.

The proposition for a 300-kw plant would compare as follows:

(1)	Three 110-kw transformers	£495
	One 300-kw rotary converter	600
	One oil-cooled reactance	90
	Total	£1,185
(2)	One 300-kw synchronous motor	£750
	One 300-kw direct-curent generator	915
	Total	£1,665
(3)	One 300-kw induction motor	£930
	One 300-kw direct-current generator	915
	Total	£1,845

These arbitrary cost figures, which are based on actual practice, and which are chosen rather favorably for the motor-generator sets, show a marked saving in capital outlay for the rotary converter—i. e., £480 when schemes 1 and 2 are compared, and £660 for schemes 1 and 3. It should be stated that these prices only hold good for the case cited by the Oerlikon Company, and have to be adjusted for any other proposition.

Fifthly.—From the point of view of floor space required, still another advantage for the rotary converter vs. motor-generator may be brought forward, as the transformers can be located either in the basement or on an elevation in the sub-station, leaving only the rotaries to be placed on easily accessible ground. With the motor-generator proposition, more than double the actual floor space is required for the two machines, and, as the sub-stations are mostly situated in a part of the town where real estate is very expensive, a further saving in capital outlay may be effected by choosing the converter instead of the motor-generator.

A number of other favorable points could be added by an advocate of the rotary converter, as, for instance, its almost unlimited overload capacity and the easy method of compounding on the alternating current side by phase control, etc. But the writer, on the other hand, fully appreciates that there are cases where the motor-generator is at all events to be preferred in spite of all the advantages set forth in this article. As this part of the subject is treated in detail by the article referred to, it is not necessary to make any further comments on it. Both classes of machines have their field, but wherever possible, from the requirements of the system, a rotary converter should be given the preference as being cheaper, more efficient and taking less floor space.

The Economic Design and Management of Telephone Exchanges—IV.

By Arthur V. Abbott, C. E.

(d) THE WIRE PLANT.

STRUCTURALLY the wire plant may be divided into (a) aerial lines, (b) underground lines.

(a) Aerial lines comprise all of the wire plant that is above the ground.

Aerial lines may be divided into (1) open wire lines and (2) aerial cables.

(1) *Open Wire Lines* are those in which individual wires are supported upon insulators set on cross arms carried upon line poles.

(2) *Aerial Cables* consist of a number of insulated conductors bunched together in a lead sheath and supported upon cross arms upon a pole line. Aerial cables are usually 10, 25, 50, and occasionally 100 pair.

Anchor Pole.—The last pole at the end of an aerial line upon which the wires are terminated, and which must be sufficiently strong to sustain the longitudinal stress of the wires.

Balcony.—A small platform built upon a pole carrying a cable head upon which workmen may stand, for the purpose of access to the cable head.

Common Return (sometimes called *McClure System*).—It was formerly customary to use the earth as one conductor for every telephone line, but inductive disturbances became so severe as to compel the resort to a complete metallic circuit to afford the best service. The use of one wire of somewhat larger section than the ordinary line wire serving as common conductor for a number of lines (a partially successful compromise between the more expensive complete metallic circuit and defective ground) has received the preceding title.

Distributing Pole.—A pole from which a number of drop wires pass to sub-stations.

Messenger, sometimes called *"strand."* A wire rope carried upon a special cross arms (usually angle iron) of a pole line and used for supporting an aerial cable.

Transposition.—By arranging the wires of an open-wire line so that instead of preceding straight along on the same pin through the entire line, each wire frequently changes from one pin to another in such a manner as to thoroughly interlace all the circuits among themselves, inductive disturbances may be prevented. Such interlacing is called *"transposition."*

Terminal Pole.—A pole carrying a cable head or terminal, sometimes called a distributing pole.

(b) UNDERGROUND PLANT.

The underground plant comprises all of the conductor installation which is placed below the street level.

Block System.—The plan or design of a telephone cable plant involving the extension from the central office of one or more main cables that are subsequently split into a number of subordinate branches and extended from one distributing point to another in series.

Cable Entrance or *Cable Run.*—Where cables, either aerial or underground, leave the street and enter the central office building, proper facilities must be provided to convey them from the street to the cable side of the main distributing board. All the space taken for this purpose, together with all the necessary supports or fittings to hold the cable, is called the *cable entrance.*

Cable-head, "Terminal" or *"Cable Box."*—A device into which a cable is extended and to which the lead sheath may be soldered forming a water-tight joint. The cable head is usually in the form of a long rectangular box, preferably of iron, upon the inside of which the cable wires may be fanned out and attached to binding posts, which project through the sides of the box, the whole being supplied with a water-tight cover. By this means the individual pairs of an aerial cable may be connected to the open wire lines by means of short pieces of wire called "bridles" or "jumpers."

Distributing Box.—A device similar to a cable head, through which a main cable passes, which permits a portion of the cable pairs to be taken off and distributed to adjacent sub-stations. Distributing boxes are now becoming obsolete, and are replaced by "Y" splices.

Lateral Cable (sometimes called "Subsidiary Cable).—That portion of the underground cable plant which extends from a main cable or distributing box to a terminal pole or building terminal.

Conduit.—A structure installed beneath the street level for the purpose of carrying electrical cables. Conduits may be divided into (a) drawing-in systems, so planned as to permit of introducing or removing the cable at any time after the structure is completed; (b) built-in systems, in which the cable is placed at the time the conduit is constructed and cannot thereafter be removed or changed. Built-in systems are gradually becoming obsolete.

Duct.—Such a longitudinal portion of the conduit as is intended for the reception of one or more cables. The tendency of present practice is to so construct conduits that each duct shall receive only one cable. Ducts are divided into:

(a) Main ducts which carry feeder cables or main cables, and (b) lateral ducts, or those which branch from the main conduit to a distributing pole or office terminal.

Encasement.—The concrete or other material with which the ducts forming a conduit are surounded for the sake of mechanical strength and protection.

Fish Wire.—A wire which is placed in a duct for the purpose of drawing in a cable.

Main Cables (sometimes called "feeder cables").—That portion of the underground cable plant extending from the office, along a highway to a distributing box or lateral cable.

Manhole (sometimes called "vault").—A chamber constructed beneath the street level and giving access to a portion of the conduit for the purpose of introducing and removing cables.

Office Manhole.—A manhole or vault, usually much larger than standard size, placed as close as possible to the central office to which

all the conduit system converges, and from which the cable entrance extends into the office.

Pot Head.—A peculiar kind of cable terminal, consisting of a piece of lead pipe somewhat larger than the cable sheath, onto which it is soldered, making an air-tight joint. Into this sleeve the cable conductors are extended and connected to okonite or other water-proof wire. The sleeve is then filled with a water-proof compound melted and poured in, thus effectually sealing the cable from the incursion of moisture, yet permitting the conductors to be extended at pleasure.

Rodding.—The operation of introducing into a duct a fish wire to facilitate the future introduction of a cable.

Section.—That portion of a conduit extending between adjacent manholes.

Underground Cable.—A collection of conductors surrounded with a lead sheath and designed for service in underground conduits. Underground cables are usually 25, 50, 100, 120, 150, 200 and 300 pair.

"Y" Splice.—The separation of a feeder cable into two or more parts by splicing to the cable one or more branch cables, the sum of whose conductors is equal to the main cable. This splice is made by soldering to the main cable sheath lead sleeves to which the smaller cables are attached, thus forming a "Y." A cable thus divided is said to be *tapped,* and each part is often termed a *tap.*

Battery Wires (also called "power wires").—Lines which are used for the purpose of carrying battery currents or electricity for other purposes than talking.

Branch Exchange Line or *Trunk.*—A line extending from a central office to a branch exchange.

Call Wires (also called "order wires").—Circuits used to permit operators to talk to each other for the purpose of giving instructions regarding exchange business.

Combination Line.—A line which is used both for talking and for telegraphing.

Distributing Line.—A line branching from a main lead running to various sub-stations. Distributing lines are usually aerial. As in many cases such lines are built in alleys they are frequently termed "alley" lines.

Drop Wires.—The portion of the subscribers' line which extends from the outside of the wall of his premises to the nearest wire run.

Long-Distance Lines.—Toll lines which extend over such a distance as to pass through the offices of a number of companies.

Main Line (sometimes called a "through line," a "trunk line" or "main lead").—A portion of the wire plant which extends from the exchange to the distributing lines.

Private Line.—A line extending between subscribers not used for exchange service.

Subscribers' Line.—A wire or pair of wires used to give service to subscribers. Sometimes called an exchange line.

Toll Lines.—Trunk lines extending outside the territory of an exchange, and upon which an extra rate or charge for service is made.

Trunk Line.—A wire or pair of wires extending between two central offices used to transmit originating calls in one office to subscribers in the other.

(e). SUB-STATION.

Subscriber's Instrument.—This term includes the complete talking and signaling apparatus used by the subscriber, and comprises a hand telephone, receiver, call bell and means of signaling. Subscribers' sets are commonly classified into cabinet desk sets, or instruments which are mounted in a kind of desk or cabinet, at which one using the telephone may conveniently sit and write; desk sets, or those which may be semi-portable by the use of a flexible cord, and so may be placed upon a table or desk; extension sets, or those consisting of a duplicate set (often of a different pattern), placed on a line that is an extension or addition to the first set, usually running to an adjoining room. The circuit in such instruments is frequently so designed that the first instrument upon the line may receive the call, and the extension instrument subsequently used on a secondary signal. The use of such circuits is common in offices where a clerk or other employe first receives the calling signal and subsequently summons his principal. Party-line sets, or instruments which are designed to be operated upon lines having more than one subscriber; wall sets, or those which are supported by being fastened to a partition wall. Each set consists of the following parts:

Transmitter, or apparatus used by the subscriber in talking to another party.

Receiver (also called *"Telephone"*).—The instrument for receiving conversation. When held in the hand receivers are called *"hand telephones."* When supported at the ear by a band or cap on the head, receivers are called *"head telephones."* Receivers are divided into common battery receivers and magneto receivers. Common battry receivers are of lower resistance than magneto receivers.

Ringer or *Bell.*—The device for making an audible signal at the sub-station, usually consisting of an electromagnet carrying a pivoted armature, to which a bellclapper is attached, the passage of an alternating current through the magnets, causing the armature to vibrate, thus sounding the bell. Ringers may be high wound, 200 to 1600 ohms (for bridging bells), or low wound, 25 to 150 ohms (for series bells).

Generator (sometimes called "magneto-generator" or "magneto").—A small hand-operated alternating-current dynamo capable of giving from 10 to 20 cycles per second, usually at a potential of from 50 to 125 volts, used for sending alternating currents to operate ringers. Generators may be high or low wound, depending upon the service to which they are to be devoted, high-wound generators giving a greater e. m. f. than the low wound.

Back Board.—Strictly the wooden board to which subscribers' sets are attached, but frequently expanded to mean the entire woodwork that is used for supporting a sub-station outfit.

Bell or *Call Bell.*—Usually understood to mean the entire signal bell, including the gongs, clapper and ringer magnets. Bells are usually designated by the resistance to which they are wound, as 40, 60, 80, 100 or 1000 bells.

Biased Bell.—This term is sometimes applied to a polarized bell, but strictly relates only to bells in which the ringing armature is pulled in one direction by a spring, and thus given a set in one direction. Pulsating currents of one polarity will affect such a bell, while it is unaffected by similar pulsating currents of opposite polarity. Used as a selective signal for party lines.

Hook or *Telephone Hook.*—A pronged support arranged on a sub-station set to hold the receiver. The hook also forms an automatic switch operating contacts in the sub-station circuits.

Induction Coil.—A coil consisting of two electrically separate windings forming a small step-up transformer. The low winding of the induction coil is placed in circuit with the transmitter, while the high winding is placed in series with the line. The office of the inductoin coil is to raise the potential of the impulses set up by the transmitter.

Polarized Bell.—A bell in which the armature or ringer cores or both are permanently magnetized so that the armature is held in a predetermined position with the reference to the ringing magnets. Currents of one polarity will then cause such bells to ring, while currents of the opposite polarity will not effect it. Used in connection with a party line as a selective signal.

Wall Plugs.—Wooden plugs placed in holes drilled in house walls to which sub-station instruments are fastened, and by which they are supported.

Edison Iron Ore Extraction in Norway.

Mr. Campbell W. Adams, of Utica, N. Y., and Mr. Herschel Roberts, of Albany, and assistants have returned from Norway, where they have been making surveys for the Edison ore milling (English) syndicate, which has recently acquired from the Norwegian Government great ore beds inland from Mo, a little settlement on the Ronen Fjord in the North Sea.

It is estimated that there are 50,000,000 tons of ore in one deposit, which, when mined, show 40 per cent iron. The syndicate now has a large force of engineers at work, and if their reports are favorable, between $2,000,000 and $3,000,000 will be expended in the mining properties.

The heaviest deposit of ore is 18 miles from Mo. Messrs. Roberts and Adams have made surveys of the harbor facilities, and for a line for a standard gauge railroad running to the mine. Turrettini, the well-known Swiss hydraulic engineer, is making plans for the building of an electric plant midway between the mine and tidewater.

There is a waterfall of 112 ft., and there is capacity for from 10,000 to 15,000 hp. The current is to be used in Mr. Edison's process of reducing the ore. This is in the Dunderland Valley. The railroad and the electric plant will be equipped by American factories.

Messrs. Roberts and Adams will spend the winter in Albany tabulating their data preparatory to submitting them to the syndicate. They will return to Norway in the spring, by which time it is expected that the work will be begun.

Electrical Tabulation in the Twelfth Census.

One of the most interesting features in connection with the twelfth United States census is the use of electrical apparatus in the work of tabulation. It is true that this special application is not new, having been employed in the eleventh census and adopted also by Canada and Austria, but in this latest numbering of the people the use of the electrical apparatus has been extended to details and departments involving far more complication than are presented by the simple data in regard to population. Many readers of this journal are doubtless familiar with this remarkably ingenious apparatus of Dr. Herman Hollerith, as it was described and illustrated very fully in the *Electrical Engineer* of Nov. 11, 1891, by one of the editors of this journal, who had opportunities for studying the system in Washington in all its details. The system in its latest use and refinements was described this year, before the American Association for the Advancement of Science, by Mr. H. T. Newcomb, to whom we are indebted for some of the very interesting data now presented.

The work devolving upon the Hollerith apparatus in the tabulation of population statistics is that it must count. This time it has been put upon the compilation of agricultural statistics which necessitated that it must also be able to perform sums in addition. The general method of controlling all the tabulating machinery invented by Dr. Hollerith is the utilization of an electric current transmitted by means of needles arranged to pass through perforations which, by their locations, express certain facts that have been transcribed, by punching, from the original schedules or other primary sources, to cards. Each of these cards, in the case of population statistics, is arranged so as to provide for a complete description of an individual, there being one or more perforations for each inquiry, the answer to which is to be tabulated, and the location of each indicating the particular answer made. In addition, certain perforations indicate geographical location. The cards used in the tabulation of statistics of agriculture are of two kinds, one providing for the transcription from the schedules of the descriptive facts ascertained for each farm in its entirety, and the other for those in regard to each product or kind of farm animals on each farm. The card first referred to has become known in the Census Office as the "farm card" and the second as the "crop card." Fig. 1 is a reproduction of a farm card except that words designating the character of the facts transcribed in each of the different fields have been added. Fig. 2 represents a farm card to which the description of an imaginary farm has been transcribed.

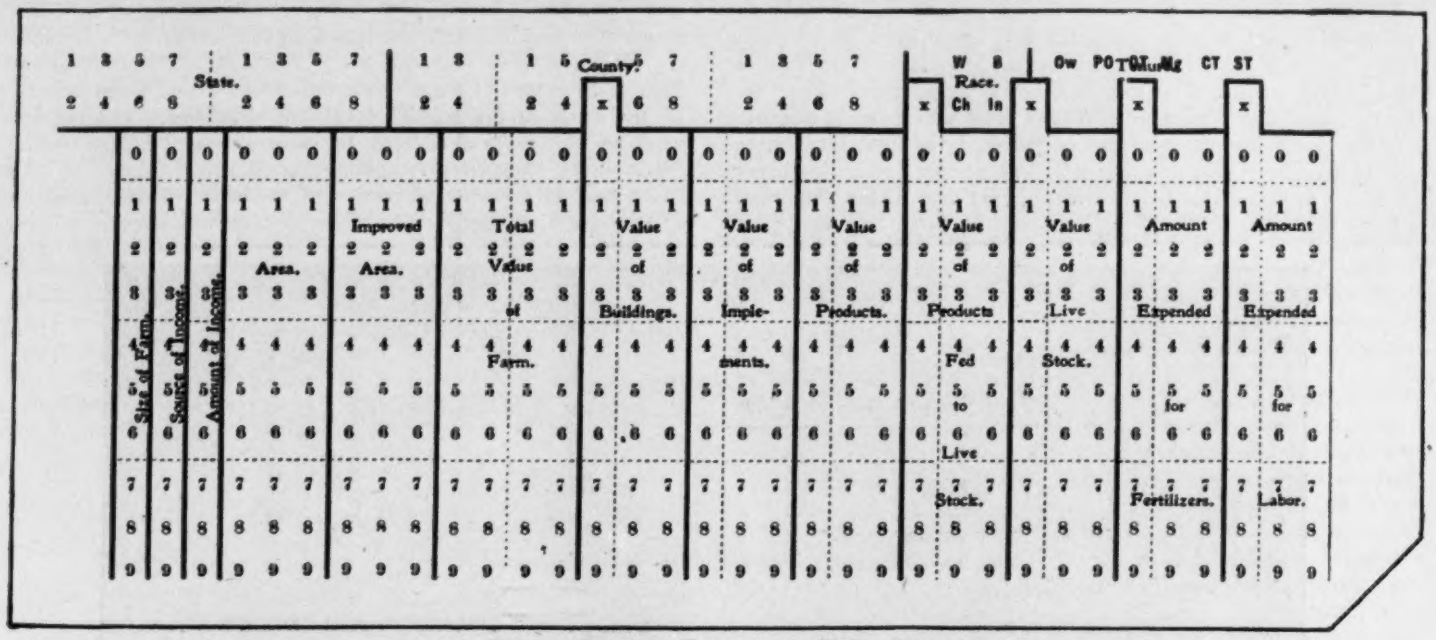


FIG. 1.—ELECTRIC TABULATING FARM CARD.

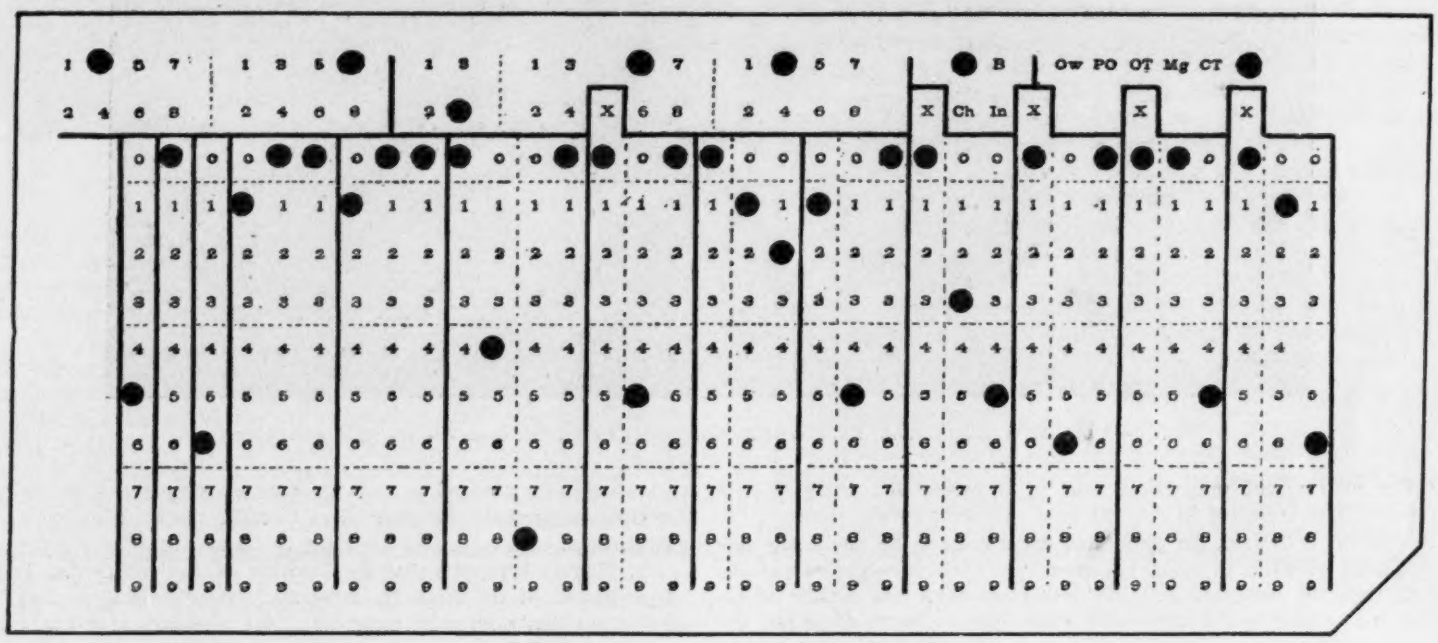


FIG. 2.—PERFORATED CARD FOR TABULATION.

The perforations indicated in Fig. 2 describe a farm of 100 acres, located in Shiawassee County, Michigan, and managed on June 1, 1900, by a white farmer who held the land as a tenant, paying a share of the products to his landlord. They show, further, that on

June 1, 1900, the entire farm was improved; that it was valued in the aggregate at $4,800, and that this total included buildings worth $500; that the implements owned or otherwise available for use in its cultivation were worth $120; that the products raised on it during the crop year 1899 were worth $1,500; that those fed on the farm to live stock during the same period were worth $350; that the live stock on the farm on June 1, 1900, was worth $600, and that the amounts expended, respectively, for labor and for fertilizers during the crop year reported were $160 and $50. It will be noticed that the units figures were disregarded in punching most of the amounts representing values. The first and third perpendicular columns at the extreme left of the card, indicated in Fig. 1 by the terms "size of farm" and "amount of income" do not provide for any additional information, but were incorporated for convenience in tabulation. They facilitate the assortment of the cards under the different size and income classes. The column between them, indicated in Fig. 1 by the term "source of income," shows from which one, if any, of 10 classes of products 40 per cent or more of the total farm income of the crop year 1899 was derived. The perforation in this column in Fig. 1 indicates that not less than 40 per cent of the 1899 income of the farm described thereon was derived from "hay and grain."

FIG. 3.—HOLLERITH ELECTRICAL TABULATING MACHINES IN U. S. CENSUS OFFICE, WASHINGTON.

The reader will understand that perforations differently located from those indicated in Fig. 2 would express different facts.

As has been said, the perforated cards control the tabulating machinery which is actuated by means of an electric current passing through the perforations. The transmission of this current is effected by feeding the cards upon a bed plate. The "bed" of this device consists of a non-conducting material with perforations corresponding to each possible perforation in the card. Each perforation in this bed is the opening of a cup of mercury which is separately connected electrically with the proper portion of the adding machinery. The "platen" holds an arrangement of pins set in springs, which are compressed by light pressure, one pin corresponding to each perforation in the bed and to each possible perforation in the card. Thus as adapted for tabulating the data that are transcribed on the farm cards (the perforations for geographical location, race and tenure are used in sorting, but not in the mechanical tabulation) each bed contains 345 cups of mercury each electrically connected with the adding machinery, and each platen consists of 345 pins, each separately and similarly connected. In their normal position these pins are extended sufficiently so that if the platen is depressed as far as it will go, upon the bed, each pin will enter the corresponding cup of mercury and form a separate electrical circuit. A properly prepared card being fed into the machine, however, and the platen similarly depressed, only those pins which correspond to perforations in the card remain sufficiently extended to enter their reciprocal cups of mercury, while the others, striking the card and meeting with its resistance, are pushed backward upon the springs in which they are set. The arrangement of the electrical connections between the actuating device thus controlled by the card and the adding machinery is such that a failure to punch an answer to any question or the omission of part of an answer, will prevent the operation of the tabulating machinery, and in this way errors of these classes are readily detected. The adding machinery consists of a series of adding devices sufficient in number separately to add the amounts of each character contained on the cards used. These adding machines work simultaneously, and each of them receives its impulse by means of the current transmitted through and controlled by the cards in the manner previously described. The tabulating machine in the form adopted for aggregating the data from the "farm cards" comprises 10 adding machines, and, in one of its adjustments, for a particular portion of the work, carries, in addition, 21 separate counting devices. Each of these machines is in charge of a single operator whose work consists of feeding and removing the cards, depressing the lever so as to make the electrical connection through each card, and recording the totals from the register.

Mr. Newcomb reports that the Division of Agriculture has been employing 12 of the large "farm card" Hollerith machines and 86 of the smaller "crop card" machines. He estimates that the total work that should be credited to them may be reckoned as equivalent to running 5,750,000 farm cards four times and 115,000,000 crop cards twice. This he sets down as being equal to adding up over 800,000,000 items, all of which otherwise would have been done as "hand work," with consequent increase of expense and labor, coupled with greater chance of inaccuracy, a much longer time in reaching results and a higher cost for the work.

In connection with the work of compiling the population and vital statistics of the Twelfth Census, the newer Hollerith development has been in the direction of an automatic tabulating machine. This machine is arranged with a magazine, into which is placed a stack of from three to five hundred cards. The machine is operated by a small electric motor, and automatically feeds the cards successively into operative position. If the card be properly punched, and tabulates, a deflector plate is operated to throw the card into one com-

partment. If, however, the card is not properly punched, or for any other reason does not tabulate, the deflector plate does not work and the card is rejected into a different compartment. After the cards for a given district have been run through the machine in this way, the rejected cards are inspected, the errors in punching are rectified, and the cards are again fed through the machine. While the operators can tabulate on the old form of machine at a speed of from 50 to 60 cards a minute, with the automatic machine the cards are tabulated at a rate of from 250 to 300 per minute, one operator being able to attend to a number of such automatic machines.

In connection with this automatic tabulating machine an automatic sorting machine has also been developed, and the automatic tabulating and automatic sorting apparatus may be combined in one machine. The sorting machine consists of a number of pockets or compartments, and a number of chutes or guides which, according to the hole punched in the card, establish communication from the magazine to the particular pocket or compartment. This automatic sorting machine is especially applicable for use with the form of tabulating machine employed for compiling the agricultural statistics, on account of the considerable amount of sorting required to arrange the farm and the crop cards according to size, character, etc., the tabulations all being made with reference to such classifications.

A new departure in connection with the present census is the use of the automatic machine for the purpose of mechanically verifying the correctness of the punched transcript. It is understood, of course, that practically the only source of error in this system of tabulation is the more or less remote possibility of a mistake in the punching of a card; but if such a mistake occurs the machine itself serves to detect it. For example, it is known that a person born abroad, residing in this country less than five years, cannot be a naturalized citizen, although such cases are sometimes reported. The machine as used for verification is connected so that the circuit through the deflector magnet will not be completed unless the card for a person punched "naturalized" is also punched more than five years in the United States. In the same way cards which are punched for certain occupations, as for example, blacksmith, shoemaker, engineer, etc., will be rejected unless the sex is punched male. Simlarly, the deflector magnet will not operate if the card should represent a male milliner. In the case of such occupations as are common to both sexes, the deflector magnet will operate for either sex. In like manner cards representing inconsistent combinations, as for instance, typewriters and stenographers who cannot read, would be rejected. Again, certain facts may be reported that, while not necessarily erroneous, are at least suspicious; for example, such cards as represented married males, less than 21 years of age, and married females less than 18 years of age, and in the case of cards so punched they are rejected by the machine for the purpose of verification by comparison with the original returns. The object is to reject all such cards as were apparently inconsistent. For example, a card might be punched correctly, except in the case of conjugal condition, where it might be punched widowed instead of single. If the age of the person was given as less than 18, of course, such a card would be rejected, and in this way if there was an error in punching the conjugal condition it would be detected. Likewise, if an error were made in punching the sex "female," and it happened to be a card relating to an occupation such as "blacksmith," such error would be detected, or at least the card would be under suspicion and investigation until the existence of a female blacksmith, or a female car conductor, or a female dynamo tender had been actually proved.

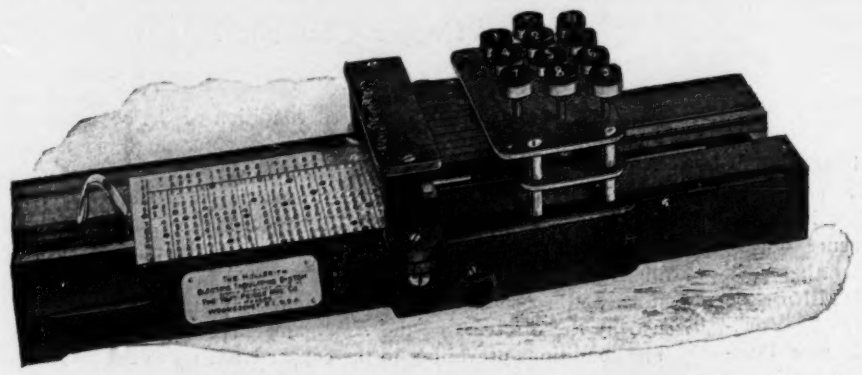


FIG. 4.—APPLIANCE FOR PUNCHING CENSUS CARDS.

A Notable Theft of Current at Madison, Wis.

Note is made occasionally of theft of current, but one of the most interesting cases is that of recent occurrence at Madison, Wis., where a small local electrician, was lately arrested by the Madison Gas & Electric Company on the charge of defrauding the Electric Company by tampering with the meter connections. The arrangement of the wires used by Mr. Harloff was very cleverly made and difficult to detect. The pressure wire running to the Westinghouse wattmeter was cut up in the partition back of the meter, and then a wire run from this pressure wire from the meter down through the partition into the basement, across the basement, then up along a wall, through the floor and into a wall receptacle, which was within easy reach of a person sitting at the office desk. From the opposite side of the wall receptacle the wire was led back down through the basement and tapped on to the same side of the circuit as the pressure wire of the meter was originally connected to.

Into the wall receptacle was screwed an extension plug, which was short circuited. When this extension plug was screwed in, the meter would register the current passing through it, as the pressure wire was then properly connected up onto the meter, though by a circuitous route. When the extension plug was unscrewed, the pressure wire on the meter was cut off, and the meter was then "dead." Several times representatives of the company on inspecting the meter found it "dead," but before leaving the building found it alive again, after some one had found an opportunity to give the plug a turn.

The offender pleaded guilty when tried in the Municipal Court, and this being his first offense he received a very light punishment. The punishment was imposed under Wisconsin Statute, Section 4415C, R. S., 1898, which reads as follows: "Any person who shall wrongfully take, entice or carry away, without the consent of the owner thereof, any bird ordinarily kept in a state of confinement, or any dog or beast of any value, not the subject of larceny at common law, or who shall wrongfully divert and apply to his own use, or wrongfully deprive the owner of any electrical current or power, or of any water stored in a dam or reservoir for use as power, or which is in pipes for the purpose of being furnished to persons who are entitled thereto, or any coal or other gas designed for use for illuminating, heating or other purposes, shall be punished by imprisonment in the county jail not more than one year, nor less than ten days, nor by a fine not exceeding $100, nor less than $5."

The company also has an alleged case against another local electrician. In the latter case, it is reported, a "jumper wire" was found permanently attached to the line wire before entering the wattmeter, and again just after leaving the wattmeter, thus giving two paths for the current, one through the current coil of the wattmeter, and one through the jumper wire. In the preliminary hearing, the man pleaded not guilty, and the case will come up in the January term of the Circuit Court.

The work of detecting the theft of the current was carried on by Mr. C. H. Williams, the superintendent of the electrical department of the Madison Gas & Electric Company, and Messrs. Schuster and Rowell, assistant professors in the electrical engineering department of the University of Wisconsin, who acted as expert witnesses. We are indebted for our information to Mr. Williams.

Bell Telephone in the Central States.

In discussing the recent telephonic developments in the Middle West, the Boston News Bureau, reflecting current opinion at the Hub, says: The Central Union Telephone and the Chicago Telephone companies have taken on a new lease of life since General John I. Sabin took charge. These properties cover the largest, but for some time the most unproductive, territory which the American Telephone & Telegraph Company controls. General Sabin has introduced Pacific Coast methods in Chicago. He has installed thousands of "nickel in the slot" instruments throughout the city of

Chicago, and within six months has served 10,000 new subscribers within the city limits, and he claims that he will bring the total up to 110,000 subscribers within the next two years. He now has nearly 275,000 telephone subscribers under his charge, divided as follows: Pacific Coast, 110,000; Central Union, 104,000; Chicago Telephone, 60,000. Total, 274,000.

Since he took charge he has not met the competition of the independent companies, but throughout the Central Union territory he has standardized rates, and announces that a subscriber can now sign a service contract at the present rates for one month or 20 years. He is letting the independent companies do their worst, on the ground that they are taking business at suicidal rates and that there can be but one result—the more they grow the quicker they will kill themselves.

On the Pacific Coast General Sabin has brought the telephone into greater use than was thought possible a few years ago. In Los Angeles, which has a population of 100,000, there are now 11,000 telephones in use, and in San Francisco, with 300,000 inhabitants, there are over 30,000 telephones. This is telephone development on the basis of 10 per cent of the population. On the Pacific Coast telephone rates are down to so fine a point that a person can have a 30-second conversation and be charged only for that time.

General Sabin believes that he can reproduce the conditions existing on the Pacific Coast in the Central Union Chicago Telephone territory. He is now adding 200 subscribers per day to the Central Union service and 100 per day in Chicago, and so far in Chicago he has secured nothing but the cream of the business. All his efforts are at present being centered in increasing the service in the Central Union territory, and he has placed this work in charge of his veteran canvassing agent, C. F. Nestor.

Postmaster-General Payne.

Henry C. Payne.

All who are interested in electrical work and electrical enterprises have noted with much pleasure during the past week that the Hon. Henry C. Payne, of Milwaukee, Wis., has been selected by President Roosevelt as his new Postmaster General. The work is not new to Mr. Payne, and the appointment has been generally welcomed with much cordiality and approval.

Mr. Payne comes of Puritan stock, and was born at Ashfield, Franklin Count, Mass., Nov. 23, 1843. His early education was obtained in the village school and also in the Shelburne Falls Academy. From this institution he was graduated at the age of 16, and went into business in Northampton, Mass. In October, 1863, he removed to Milwaukee, Wis., in which city he has since resided. His first business engagement was with a dry goods house, with which he remained four years. In 1872 Mr. Payne became interested in politics, and assisted in organizing the Young Men's Republican Club, which later became the Republican Central Committee, of Milwaukee County. He was afterwards chosen chairman of the State Central Committee. For ten years following 1876 he held the office of postmaster of Milwaukee, having been appointed by President Grant. Mr. Payne has for a number of years been prominently identified with the business interests of Milwaukee, as president of the Wisconsin Telephone Co., a director of the First National Bank, president of the Milwaukee & Northern Railway Co., vice-president of the Milwaukee Electric Railway & Light Co., controlling the electric lighting and street railway interests, and in lumber enterprises in the timber belt of Wisconsin. Mr. Payne has also served a successful term as president of the American Street Railway Association. Mr. Payne is popular with all who know him, either socially or in a business way, being a man of engaging manners and of genial disposition. His activity as a Republican national leader has given him considerable public prominence as well as the warm personal friendship of such men as Senator Hanna and other exponents of Republican policy.

Committees of the Automobile Club of America.

The following standing committees have been announced for 1902:

Technical Committee.—Dr. Schuyler Skaats Wheeler, chairman; Peter Cooper-Hewitt, Lewis Nixon, Louis Duncan, L. T. Gibbs, E. T. Birdsall, A. L. Riker, Professor Elihu Thomson.

Runs and Tours.—Jefferson Seligman, chairman; George B. Adams, Frank Eveland, John Aspinwall, J. C. McCoy, Percy Owen.

House Committee.—J. M. Hill, chairman; William Iselin, Bradford B. McGregor, Samuel H. Valentine, Henry K. Browning.

Library Committee.—Albert R. Shattuck, chairman; James L. Van Alen, T. C. Martin.

Membership Committee.—General George Moore Smith, chairman; Juan M. Ceballos, Sidney Dillon Ripley.

Laws and Ordinances.—George F. Chamberlin, chairman; Judge James C. Church, Dave H. Morris, Henry Rogers Winthrop, William W. Niles, Morris Putnam Stevens.

Sign Post Committee.—A. Ward Chamberlin, chairman; George B. Adams, Frank Eveland.

Good Roads Committee.—Albert R. Shattuck, chairman; George R. Bidwell.

Committee on Foreign Relations.—J. Dunbar Wright, chairman; Clarence Gray Dinsmore, Hart O. Berg, Eugene Higgins.

Racing Committee.—Albert C. Bostwick, chairman; Dave H. Morris, Clifford Brokaw, William Henry Hall, George Isham Scott,

Auditing Committee.—George W. Young, chairman; W. M. Van Norden, W. McMaster Mills.

Copper Conditions.

The recent agitated and depressed condition of the copper market has already been noted in these pages. Further attention is called to the subject by the cut in the quarterly dividend of the Amalgamated Copper Company to 1 per cent, and the reduction in the price of copper virtually to 12 cents. The stock of the concern now selling at about 65 was double that figure only six months ago, and millions have been lost all over the country in consequence by investors and speculators. The following statement has now been issued by the directors of the Amalgamated Company:

The conditions prevailing in the copper trade up to the commencement of the present year were very satisfactory, and so far as this country is concerned are still so, every copper wire, brass and electrical manufacturing concern being run to its full capacity. A large proportion, however, of the copper produced in this country has to find a market abroad. The unsatisfactory trade conditions which have existed during the present year in Europe, together with the fact that the supplies of copper to Europe from sources outside this country have increased, have jointly caused a falling off in exports of about 65,000 tons. This decrease has in some degree been compensated for by increased domestic consumption.

By adopting the policy of maintaining a firm price, a large proportion of the loss arising from the decrease of exports has been borne by the companies whose shares are owned, wholly or in part, by the Amalgamated Copper Company. This policy has in the past been the best for these companies, as the portion of the copper which has been sold has realized a larger profit than would have been realized had all the copper which had been produced been sold at a much lower price. It has likewise prevented fluctuations in price, which would tend to demoralize the business of manufacturers consuming copper.

The officials of these various companies, after carefully considering the situation in all its phases, decided that it would be better, in the interests of the companies they represented, to refrain from forcing upon the market more copper than was actually needed, as such action would only have led to abnormally low prices. The selling agents of these companies were, therefore, instructed not to attempt to force upon the market more than was actually needed for consumption, but to maintain a firm price. If officials of other copper producing companies had taken the same view of the situation and maintained a firm price, there is little doubt that the present unsettled conditions of the market would have been in part, if not wholly, obviated.

During the present month the United Metals Selling Company, the selling agents for the companies in which the Amalgamated Cop-

per Company is interested, has, nothwithstanding these conditions, sold considerably over 100,000,000 lbs. of copper for future delivery.

During the last two years the companies in which the Amalgamated Copper Company is interested have equipped their mines and smelters with the latest improvements and most modern labor saving appliances, and one of these companies has built the largest and best equipped smelter in existence. This can be put in commission early in the new year, so that from now on these companies can produce copper at a cost that can successfully compete with any copper producer in the world. The future prosperity of the copper business depends largely upon such a revival of foreign trade as will bring the total consumption of copper nearer to the production than is the case at present.

Marconi and Trans-Atlantic Wireless Telegraphy.

The ill-advised action of the Anglo-American Cable Company in interfering with the trans-atlantic signaling experiments of Marconi, will probably result in interrupting all further work in this line on the part of Mr. Marconi until he has established a station in Nova Scotia or elsewhere. The action of the Cable Company has met with severe criticism everywhere, and especially in Newfoundland. Ex-Premier Sir William Cavendish, in a letter to the press, advocated that the legislature cancel the Anglo-American Cable Company's monopoly, even if it be necessary to compensate the company for any damages sustained during the unexpired period of two years. A local St. Johns paper suggests to Mr. Marconi that he seek a site on the French shore of Newfoundland from the French Government, arguing that this step would probably induce the British Government to secure the withdrawal by the Anglo-American Company of its opposition to the location of a station at St. Johns. The trepidation exhibited by the Anglo-American Company resulted in a large drop in the stock market value of its shares.

Professor Alexander Graham Bell has offered the use of his estate in Cape Breton as the site for a wireless station. Finance Minister Fielding, of the Dominion Government, offered to Marconi, on behalf of the Canadian Government, every facility for locating wireless telegraph stations on the Nova Scotia seaboard. In consequence of this offer Mr. Marconi, it is stated, will, instead of returning to London, leave by the first steamer for Ottawa.

On Dec. 19 Sir Cavendish Boyle, Governor of Newfoundland, gave a luncheon in honor of Marconi, which was practically a state affair, Premier Bond, the Cabinet Ministers and the heads of departments being present. In replying to a toast by Governor Boyle, Mr. Marconi referred to the important factor in the progress of civilization which lies in a facility of communication between different countries and said further:

"If my system of wireless telegraphy can be commercially established between different parts of the earth, of the possibility of which I may state, I have not the slightest doubt, it would bring about an enormous cheapening in the methods of communication at present existing. The system of submarine cables of to-day fulfils the demands of communication to a great extent. But the great cost of the cables themselves and their heavy working expenses cause the existing method to be beyond the reach of a majority of the people inhabiting the various countries of the world. But could this new method be applied, I believe the cost of what we now call cabling to England might be reduced at least twentyfold. The present rates are 25 cents a word. I do not see why, eventually, with the wireless system, this cost should not be reduced to one cent a word or less."

Observing that he was half an Englishman by birth, Mr. Marconi continued:

"With regard to the British Empire, the wireless system has quite a special importance, as facilitating the methods of communication between the mother country and her great colonies beyond the seas, and it cannot but result in still more firmly cementing the bond of unity and a common cause in the interest of civilization, of which the empire has, during the anxious times of the last two or three years given such a splendid example to the world. This colony of Newfoundland is the first in which a message was received by cable from across the ocean, and I am glad to say it has also been the first to receive a message across this same ocean without a cable. It is my sincere wish that if there is anything useful in my method, that this country should not be the last nor the least in participating in its benefits. It is my sincere wish that Governor Boyle and the members of his government may, in the future, always have cause to look back with satisfaction to the great assistance and encouragement they have afforded me in the carrying out of my work."

New York Electrical Society and Polarized Light.

At the College of the City of New York at the 219th meeting of the New York Electrical Society on the 19th inst., before a large and enthusiastic audience, Professor Dayton C. Miller, of the Case School of Applied Science, Cleveland, Ohio, lectured on "Polarized Light." The nature of light considered as a wave motion in the ether was explained by means of models and demonstrations. The meaning of the term, "polarized light," was illustrated with the aid of a series of original models and projections with double image prisms and tourmaline plates. While this kind of light is everywhere, the eye does not thoroughly detect its peculiarities, and some form of analyzer is used to find it. To obtain polarized light in convenient form for experimental investigation, a polarizer is also required. These two devices constitute the polariscope. The conditions were considered upon which interference or refraction and dispersion may produce various colors, from white light, and demonstrations were made, including the projection of the spectrum of the arc light. The essential features and offices of the several parts of the polariscope in various forms, consisting either of Nicol prisms, glass piles, or other polarizing devices, were brought out, and the effect produced upon polarized light by thin films of doubly refracting substances was shown. Professor Miller stated that the colors which are produced are always pleasing, because they may be made to occur in complementary sets. These effects were vividly and beautifully illustrated. Polarized light is not only of scientific interest, but it has many important applications. Among these is its use in the study of mineralogy in enabling genuine emeralds, rubies and other precious stones to be distinguished from artificial ones. It is used extensively for determining the purity of sugar and for many purposes of chemical research. It is an important aid in the glass industry to determine whether the product is properly annealed. If imperfectly annealed, internal strains result and the glass may burst, and glass strained is worthless for optical instruments. Very striking examples of glass under strain were shown. Polarized light may be used also as an aid in artistic designing, and it furnishes scientific amusement of the most interesting kind. Perhaps no other experiments give such exquisite color effects as are produced by natural or artificially arranged crystal plates. The pictures are not only beautiful and complicated in design, but are brilliantly tinted. A movement of the specimen causes one combination of colors to dissolve into another in a fascinating manner. While the light reflected from the polished top of a table is polarized and a fragment of glass is sufficient to render these effects partly visible, yet complicated optical instruments are necessary to show them in all their perfection. In the lecture Professor Miller employed a large and complete projection polariscope, and a Nicol polarizer of more than 2½ inches aperture and many accessories for the purpose of demonstrating these phenomena by the aid of electric light. A collection of unusually perfect specimens of crystals and special preparations was exhibited. The attention of the audience was held closely all the time, and the applause was frequent and hearty, there being a great many present who could appreciate the cleverness and skill of the lecturer as an experimental demonstrator.

The following members were elected: Frank Scott, Crocker-Wheeler Company, Ampere, N. J.; Hugh A. Brown, 64 Orient Way, Rutherford, N. J.; Edward B. Brisky, 102 West Seventy-fifth street, New York City; Raymond Healy, 26 South Oxford Street, Brooklyn, N. Y.; F. J. Youngblood, 1034 Broomfield Street, Hoboken, N. J.; Vernon E. Royle, 618 East Twenty-eighth Street, Paterson, N. J.; Thaddeus R. Bell, 197 Wooster Street, New York City; W. Jac Marland, 249 West 123d Street, New York City; W. H. Brown, 1880 Lexington Avenue, New York City; Richard Braithwaite, 237 Fourth Street, Jersey City, N. J.; William E. Toldt, 497 South Tenth Street, Newark, N. J.; M. F. McAlpin, 55 Duane Street, New York City.

A Woman in Independent Telephony.

It is stated that Mrs. Anne McElroy Brett is president of the Southern Independent Telephone & Telegraph Company, of El Paso, Texas, and president and general manager of the Brett Construction, Telephone & Telegraph Company. In 1893 her late husband organized the Detroit independent company to fight the Bell telephone monopoly. Governor Pingree was just coming into power in Michigan, and he became interested in Mr. Brett's fight, and gave it a vigorous backing, with the result that Detroit acquired an inde-

pendent telephone system. Mr. Brett was an invalid, and all of the work was directed from a sick room. Mrs. Brett was her husband's chief lieutenant, and following his death, two years ago, she invaded the telephone field, making her start at El Paso. She is now at the head of several companies, and is financing telephone companies at Alamo Gordo, Texas, and Deming, N. M., under the firm name given above. In appearance Mrs. Brett is more the young woman of leisure of fashionable society than the active, persistent and successful worker in a new electrical field.

Mrs. Brett expects to carry her line from El Paso to San Antonio, and from thence to Kansas City. Another line will run from Deming, N. M., to Silver City, thence to Denver, and from Denver to Kansas City. It was two years ago that Mrs. Brett set about securing an up-to-date telephone system for El Paso. It was an uphill fight for some time, but finally she secured the backing of Cleveland capitalists, and then she set about securing patrons, and says that she got contracts from 90 per cent of them for three years. Next she applied for a franchise, and fought the City Council for nearly a year before she could get the franchise. She now has three-year contracts for 1200 telephones in and about El Paso.

New Telephone Patents.

Telephone patents of the issue of Dec. 17 touch low-water mark in point of numbers, as there are two only. These two are wide apart as the poles, both in object and in complication, one being a fire-proof covering for overhead telephone cables and simplicity itself as to design and construction; the other a selective belt system, complicated as only a selective bell system can be.

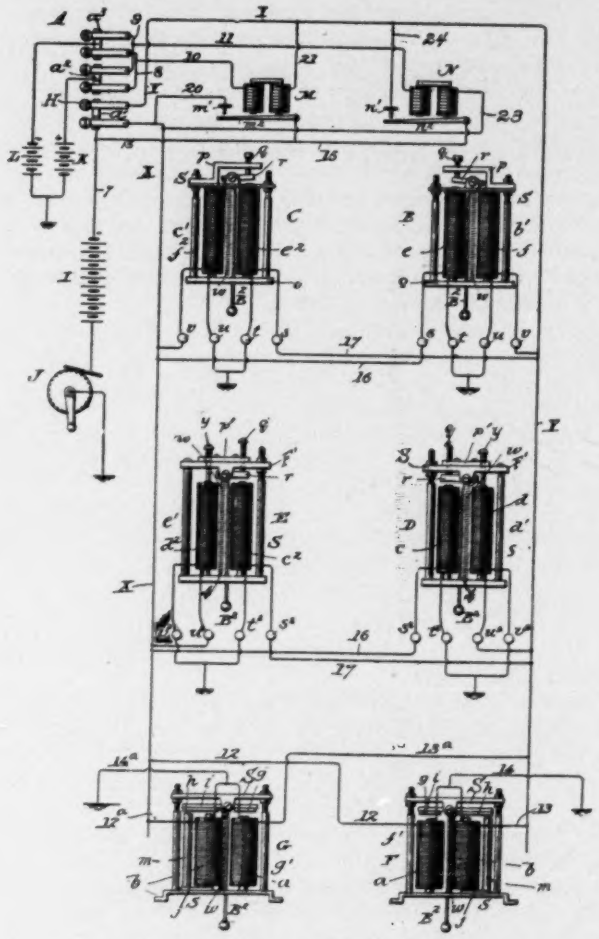
Mr. Frank D. Saylor, of St. Louis, patents a fire protector for telephone-cables, which consists of a split tube of asbestos formed over a strip of steel gauze, bent in the form of a tube, to give it mechanical strength and form. A number of these tubes of increasing diameter are telescoped together with appropriate guides and stops, and an asbestos covered rope is attached to the innermost tube by means of which the whole telescopic combination may be hauled over the cable when danger from fire occurs and hauled back and closed up when the fire is out. Mr. Saylor's idea is that when a fire breaks out in a building equipped with roof fixtures carrying telephone cables the firemen "or others" would spring these asbestos telescopes over the telephone cables, proceed to the next fixture or pole and haul on the asbestos covered rope until the cable was fully covered by the protective telescope. In suggesting that the firemen "or others" would do any such thing the inventor shows very little knowledge of the ways of firemen—and others. The firemen would be much more likely to use their little hatchets on the cables than to wrap them up in asbestos telescopes, and as for "others"—well, it strains the imagination a little to picture volunteers working to put jackets on telephone cables with a bad fire raging beneath them. One would think when an impractical device like this is deemed worthy of patenting that simplicity in invention could no further go.

There is nothing at all simple about the selective telephone system patented by Mr. John V. Stout, of Easton, Pa. This system relates to selective signals for party lines worked from an exchange. It is of the "strength and polarity" family, and is apparently limited to six bells, although this is not expressly stated. The general principle of the system is to make one coil of each ringer magnet the working coil to act on the armature for ringing purposes, and the other coil an opposing or assisting coil, as the case may be.

Referring to the accompanying diagram, it will be seen that the two line wires *X* and *Y* each go to ground at each station through one of the magnet coils. Line *X* carries coil f^2 at station *C*, *e* at station *B*, d^2 at station *E*, *c* at station *D*, *b* at station *G* and *a* at station *F*, *e*, *c* and *a* being ringing coils and f^2, d^2 and *b* opposing coils. Line *Y* carries *f* at station *B*, c^2 at station *C*, *d* at station *D*, c^2 at station *E*, *b* at station *F* and *a* at station *G*, e^2, c^2 and *a* being ringing coils, and *f*, *d* and *b* opposing coils. The call-bell magnets, it will be seen, are of different construction at the different stations, although those at *C*, *B*, *D* and *E* are practically similar, except for slight differences in detail in the arrangement of the soft iron polarizers *p* and p^1.

The magnets at *G* and *F* are different from the others in that they employ two armatures *g* and *h* attached to a strip of non-magnetic metal *i* (which is pivoted and carries the bell hammer B^2), these armatures are opposite the poles of the ringer magnet *a* and the club-footed magnet *b*, with bare cores *m*, respectively. In all cases the bell hammer armatures are held away from the magnets by springs *w* and magnets *b*, of stations *F* and *G*, serve to hold the armatures in their normally retracted positions when those magnets are energized. At the central office there is a keyboard having six keys. Tracing the connections it will be seen that key 1 puts battery *I* (having an interrupter *J* in circuit) to line *X*, key 2 puts battery *I* to line *Y*, key 3 puts positive current from battery *K* through magnet *M* to line *Y*, and causes *M* to close the contact at m^1, and so put battery *I* to line *X*. In the same key 4 puts *K* to line *X* through *N*, and causes *N* to close contact, putting battery *I* to line *Y*, and key 5 puts negative current through *M* to *Y* and causes *M* to connect *X* with *I*, lastly key 6 puts negative current through *N* to *X* and causes *N* to connect *Y* with *I*.

When key 1 is depressed the bell at station *F* is rung, and key 2 rings station *G*. These two ringers respond to either polarity of current, it being only necessary that the current shall be strong enough to overcome the tension of spring *w*. The other four ringers of the system are so adjusted by means of the retracting springs *w*



SELECTIVE TELEPHONE SYSTEM.

that they will not be affected by the current. Key 3 rings station *B* as follows: Positive current flows over *Y* through the magnets connected with it to ground, but is not strong enough to attract any of the armatures; current from *I* flowing through *X*, however, actuates magnet *e* the strength of *e* being augmented by *f*, which is energized by the constant current from *K*. The ringer at *D* will not operate because *d* here becomes an opposing instead of an assisting coil, and *F* will not ring because magnet *b*, energized by *K*, aids spring *w* in holding the armature against the attraction of *a*. Similarly key 5 rings station *D*, and keys 4 and 6 ring *C* and *E*, respectively.

The system has been worked out with a painstaking amount of ingenuity, and 19 claims are required to set out the various combinations for which protection is demanded. A selective system is naturally complicated, and this one is not more so in its wiring and auxiliary appliances than many of its prototypes. One is apt to doubt whether in practical working the spring adjustments on which dependence is placed to maintain some of the signals silent when others are being rung would always give the desired performance.

CURRENT NEWS AND NOTES.

THE ASIATIC ASSOCIATION, which includes 200 firms interested in trade in the Far East, has addressed President Roosevelt in favor of private ownership of the Pacific Cable. It also wants pledges from Russia that the door of Manchuria shall be kept open.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—Over 200 persons have already enrolled for membership in this proposed new society, and the first meeting for definite organization and reading of papers and discussion will probably be held in Philadelphia about Easter. An enthusiastic gathering of electro-chemists from all over the United States is assured.

NEW ORE SEPARATOR IN SWEDEN.—Consul Bergh reports from Gothenburg as follows: *The Morning Post,* of this city, says that Knut Ericson, an engineer, has invented an apparatus for the separation of ore by the magnetic method, and last September exhibited it before Swedish and foreign experts. The apparatus, which is very simple in construction, yet ingenious, attracted wide attention. A Swedish company is being organized to work the invention. It is believed that it will be of the greatest importance for mining.

DIPLOMACY BY TELEPHONE.—A dispatch from Marseilles to *The Times* reports the refusal of the Negus Menelek to grant mining concessions in his equatorial provinces to engineers of the Abyssinian Exploration Company. The engineers encamped outside the walls of Harar and telephoned their request. The Emperor replied by telephone that he would not grant fresh mining concessions till he knew the first results of the existing concessions. Such methods, if generally adopted, will result in considerable economy of official etiquette and court uniforms.

WESTERN INDEPENDENT TELEPHONY.—A telegram from Minneapolis of Dec. 19 says: It was learned here last night that the owners of the independent telephone lines in Wisconsin, Minnesota and Northern Michigan will unite to form a long-distance toll-line service in the Northwest, to compete with the Erie system. It is said that the Milwaukee Telephone & Telegraph Company, which is now seeking a franchise in Milwaukee, is a part of the proposed new company. It is also rumored, though denied, that the Twin City and the Rapid Service Companies of this city are to be included. Every independent line in Wisconsin and Northern Michigan is said to be interested, and there will be a meeting of the owners of the independent lines at Milwaukee in February, at which the matter will be discussed.

THE GROWTH OF WORDS.—Profesor Brander Matthews, of Columbia University, discussing in *Scribner's Magazine* the use, abuse, decadence and growth of English words, says: "'Telegram' was denounced as a mismade word and 'cablegram' was rejected with abhorrence by all defenders of purity. Yet the firm establishment of 'telegraph' and 'telephone' made certain the acceptance of 'telegram.' 'Cablegram' is still on probation, and may fail of admission because a part of the word seems better fitted for its purpose than the whole. Mr. Howells, always bold in using new words, accepts 'fake' as good enough for him, and prints it without the stigma of italics or quotation marks, just as he has adopted the colloquial 'electrics' for electric lights. And hereafter the rest of us may use either with a clear conscience, for Mr. Howells can always give a good account of himself when attacked. American contributions to the English language are not a few. Some are brand-new words, minted at the minute of sudden demand, and well or ill made as chance would have it. 'Phonograph' is one of these."

"SEEING BY TELEPHONE."—A disptach from Paris of Dec. 18 says: Dr. Sylvestre, the inventor who claims to have discovered how to see by telephone, has just described his remarkable discovery, which he declares was a matter of chance. He said: "There is no reason why as soon as telephonic cables are established between Paris and New York we should not see our friends there as easily as I see you. I have already seen the Marseilles Telephone Exchange from this room by means of my apparatus, and I have chatted by telephone with M. Mougeot, the French Postmaster General, watched his astonishment and described his appearance, his clothes, his office as we talked." The dispatch continues: "Dr. Sylvestre showed a small circular mirror, with a hole in the center, into which is screwed a tiny electric light of 1-10th candle-power. This is fixed to a telephone's microphonic plate by an india rubber band, a pencil-like instrument connecting the current with the apparatus. Two acids are allowed to mix, drop by drop, in a torpedo-like machine, about 3 inches long. This process throws what Dr. Sylvestre terms a phosphorescent flame on the looking glass connected with the poles, and pencil and a sheet of any white, semi-transparent tissue, placed before the glass, shows the rooms in which the other person is telephoning, no matter how many miles away that person may be."

ELECTRIC FURNACE.—A novel form of electric furnace, suited especially for large units, is described in a patent issued Dec. 17 to Charles Albert Keller, of Paris. The electrodes take the form of trucks mounted upon rails and each adjustable toward a central horizontal firebrick hearth which carries the main body of the charge. The electrode carriages are framed in iron and covered by a raised arch of firebrick, upon which, inclined slightly toward the hearth and with its lower edge level therewith, is the carbon or other surface which constitutes the working face of the electrode. The central horizontal hearth and the upwardly inclined lateral electrodes together form a broad shallow furnace bed, over which a layer of granular carbon is spread. This layer serves to close the circuit between the electrodes and by its resistance to develop a temperature sufficient for the reaction desired. Or if such excess of carbon would be injurious, other resistance material may be substituted, either the charge itself or one of its components being so employed. For instance, in the production of chrome-iron, the carburization of which is to be avoided, a bed of granular iron may be used to develop the necessary heat, the metal being alloyed as reduced. The furnace proper is enclosed by a firebrick vault to conserve its heat and exclude the air. The specifications show a careful elaboration of details and the construction seems thoroughly practical.

ELECTRICITY IN BERLIN.—Consul-General Mason, of Berlin, reports that the electricity works of Berlin now supply from its generators 353,253 incandescent and 14,274 arc lamps, besides 6426 electric motors of 21,448 aggregate horse-power ,and that of this 49,949 incandescent lights, 1878 arc lamps, and 1462 motors were newly installed within the circuit of that one company during the year which ended on the 1st of October. This increase of 21 per cent in the consumption of current, of course, does not take into account the numerous large new buildings, factories and other establishments which have independent lighting, and power plants under private ownership and control. The development of electrical tramway lines has been on a phenomenal scale. One year ago the aggregate electrical energy consumed for this purpose was 8000 hp; it is now 16,800 hp, having more than doubled in a single twelvemonth. When the principal city lines were changed from horse to electric equipment, the municipality held out firmly against the use of overhead conductors in the central districts. The trolley was tabooed on all except suburban routes, so that cars intended for use on lines running from the central portions of Berlin to outlying districts were equipped for both methods of transmission—trolleys for suburban sections and heavy storage batteries to carry them over the downtown portion of their route. This made the cars heavy and costly, but they worked fairly well until a 6-inch snowfall exhausted the already overtaxed current supply, and filled the busy downtown streets with "dead" cars that had to be hauled out by horse-power. From that time the overhead wires crept farther and farther into the city, until they now substantially supply most of the lines throughout their entire length. This vastly improved service—especially the greatly accelerated speed on the suburban lines—has practically revolutionized the conditions of public transportation in Berlin, and has drawn a constantly increasing percentage of population to Halensee, Charlottenburg, Friedenau, Wilmersdorf, and a dozen more populous and handsomely built towns which have sprung up in recent years within a radius of 7 or 8 miles from the cathedral of Berlin. Of the entire consumption of current, 21 per cent is used for lighting, 22 per cent for miscellaneous power purposes, while the remaining 57 per cent are charged to the tramway lines. The average price to consumers in Berlin is 4.5 cents per kw-hour, and the total current supplied by the company increased from 62,349,846 kw-hours in 1900 to 89,668,258 in the fiscal year 1901.

LIBRARY OF THE UNIVERSITY OF CALIFORNIA

CHICAGO BUCKET SHOPS.—Several members of the Chicago Board of Trade have been expelled for collusion with bucket shop keepers in furnishing quotations, etc.

NEW YORK CENTRAL.—*The Boston Herald* says that the New York Central has sent out for estimates of the cost for electrically equipping the Newton circuit of the Boston & Albany. The company figures the cost at about $1,000,000.

AMERICAN MANUFACTURES.—The U. S. Census Office has about completed its manufacturing statistics. The value of the manufactured output for 1900 exceeded $13,000,000,000, an increase of $4,000,000,000 over 1890, a 30 per cent increase. The value of American manufactures in 1900 was almost 13 times that of 1850.

THE NORTHWESTERN ELECTRICAL ASSOCIATION.—The tenth annual convention of the Northwestern Electrical Association will be held at Milwaukee, Wis., on Jan. 15, 1902. Reports and papers on subjects of special interest to central station men will be read and discussed. Mr. Thomas R. Mercein is secretary of the Association.

STEAM RAILROAD TROLLEYS.—It is announced that on Christmas Day the Webster (Mass.) extension of the People's Tramway Company in the northeastern part of Connecticut will be opened. This will give a through trolley line, more than than 35 miles long, between Danielsonville, Conn., and Worcester, Mass., paralleling closely the Norwich and Worcester division of the New Haven steam railroad system, and it is well understood that the New Haven Railroad Company controls the parallel for the purpose of regulating competition and developing lateral trolley feeders for freight traffic.

AQUEDUCT THROUGH A MOUNTAIN.—The Vancouver Power Company, a corporation allied to the British Columbia Electric Railway Company, which owns all of the tramways in the province, will soon undertake a novel piece of hydraulic engineering work in connection with an electric transmission project. A water power electric generating station is located near the headwaters of the Coquitlam River, and to add to the supply of water furnished by a dam it is proposed to tap a lake at an altitude of 2500 ft. above the sea. Instead of laying a pipe line, the company will drive an inclined tunnel through a mountain of solid rock. The bore will be 3 by 8 ft., and 2½ miles in length. The cost of the tunnel is estimated at $350,000. The cities of Vancouver, B. C., and New Westminster will be supplied with current from this source.

WATER POWER DEVELOPMENT IN INDIANA.—Electricity generated by water power seems to be attracting attention in Northern Indiana, a portion of the State where coal is scarce and too expensive for profitable use. The conditions on the St. Joseph and the Tippecanoe rivers are particularly favorable for development in this direction. Citizens of South Bend are constructing a dam in the St. Joseph River for the development and transmission of electrical energy to a number of cities and towns for light and power purposes. Capitalists of Lafayette and Monticello have purchased a large tract of land on the Tippecanoe River, and propose to dam the swift stream at a bend in the river and cut a channel across at a point one-half mile wide getting a fall of 50 ft. It is proposed to transmit electric power to towns and cities in that section. There are other streams in Indiana equally available for water power.

TELEGRAPHY IN ARABIA.—Reports are published of the strenuous opposition offered by the wild tribesmen in Arabia to the construction of the telegraph line the Turkish authorities are carrying to Hodeida, on the Yemen littoral of the Red Sea. A gunboat was sent from that port to put a stop to the interference of the Arabs with the work of the engineers, but it had only a temporary effect, for, on its departure, the wires were again cut and the work otherwise impeded. The main object of the line is to have the Yemen officials under more direct control from Constantinople, but it is doubted whether the work will ever be successfully accomplished, since the tribes along the coast are not sufficient subdued to be persuaded to desist from their opposition, and the effective guarding of the line by troops would be so costly as to be out of the question.

ADIRONDACK TROLLEYS.—The Adirondack air is filled with rumors of trolley road building. Just now two roads are projected from Lake Champlain to Lake Placid and Saranac Lake, one via the Ausable Valley and the other via Keene Valley, as noted recently in these pages. The erection of electric power plants on the streams of that part of the Adirondacks makes these roads a greater possibility than ever. One company is the Keesville, Ausable Chasm, Lake Champlain Railway; its route being through Clintonville, Ausable Forks, Jay, Wilmington, Keene and Lake Placid. We have given details in regard to this. The second company is promoted by Paul Smith, the hotel man, and Wallace Murray, of Saranac Lake, and its line will be the first trolley road through the eastern Adirondacks. The route is to Saranac Lake via Keene Valley, and through the purchase of water power at Franklin Falls, Saranac Lake, and Halls Falls, they have sufficient power to operate an extensive electric line.

ALTERNATING-CURRENT METER.—A patent issued Dec. 17 to K. O. F. Schrottke, of Berlin, Germany, describes an alternating-current meter which has for its object the provision of an improved means for adjusting the phase difference between the shunt field and the voltage impressed upon the shunt circuit. As illustrated, the principle is applied to a motormeter with a ring field having four projecting poles 90 degs. apart. Designating the legs of a three-phase circuit by the numerals 1, 2 and 3, the leg 1 is in series with the windings on two opposite poles; the other two opposite poles each carry a separate shunt winding, one of which is connected across the legs 1 and 3, and the other across the legs 1 and 2. The two shunt coils are wound in opposite directions. The field due to the coil 1-3 is dampened, and that due to the coil 1-2 is strengthened in order to maintain the desired displacement of 90 degs. To obtain a resultant field perpendicular to either of the shunt voltages, the ratio of the ampere turns between the coils is changed until the displacement of the resultant field has reached its desired magnitude.

TREATMENT OF EXHAUSTED CYANIDE SOLUTIONS.—A method, in part electrolytic, for the regeneration of fouled cyanide solutions, is covered by a patent recently issued to William Orr, of Salt Lake City, Utah. The dilute cyanide solution employed for the extraction of gold from ores or tailings is extremely sensitive, its solvent power varying widely under different conditions of concentration and temperature, depending largely on the free access of oxygen, and decreasing to a marked degree under the influence of dissolved base metals. In use these solutions become quickly weakened from the presence of copper and zinc, the former derived often from the ores, and the latter from the precipitation vats, and both existing in the form of double cyanides which are without solvent action on gold. If zinc alone be present the fouled solutions yield readily to known methods of treatment, but in the presence of both copper and zinc the familiar chemical reactions fail, owing probably to the formation of complex ions not susceptible of direct precipitation by the usual reagents. Solutions of this character are electrolyzed, according to the new method, with anodes of zinc and cathodes of copper, whereby the copper separates out in metallic form and the zinc of the anode enters into solution as a cyanide, replacing the corresponding copper salt. After this preliminary treatment the solution is rendered alkaline by a mixture of sodium and calcium hydrates and the zinc thrown down as sulphide, care being taken to avoid excess of the precipitant. The solution, thus restored as regards its content of free cyanide, is returned to the ores.

LETTERS TO THE EDITORS.

Direction of Street Car Travel.

To the Editors of Electrical World and Engineer:

Sirs.—In ELECTRICAL WORLD AND ENGINEER for Sept. 21, I notice a report of the annual meeting of the New York Street Railway Association, in which there is a suggestion from Mr. Rogers that if the direction of traffic on the street were the same as in England, that is, the traffic (including cars) keeping to the left hand, many accidents,

especially those caused by ladies alighting from a car facing backwards, would be avoided.

I have had over five years' experience on a tramway operated under the conditions suggested by Mr. Rogers, and find that ladies still get off facing backwards. My explanation is that a woman never signals a car to stop until it is past the place where she wants to get off, and that when she gets off she makes a bee-line for the objective point, which is nearly always towards the rear of the car.

J. S. BADGER.

BRISBANE TRAMWAYS, QUEENSLAND, AUSTRALIA.

A 10,000-Volt Shock.

To the Editors of Electrical World and Engineer:

Sirs.—We notice you have a paragraph in your issue of Nov. 23 referring to a 10,000-volt shock at Mascara, Algeria. The installation is a 20-mile three-phase transmission of power at 10,000 volts, which we put down at Mascara some years ago. The engineer, Mr. Viel, who received the shock is one of the men sent out by us to erect and look after the plant. The matter is, of course, the subject of an official inquiry at the moment, but there is no doubt the shock was given through a telephone wire, and was caused by a dissatisfied workman connecting the telephone wire with one of the line wires. From advices we have received, Mr. Viel was burned very badly on his left side, and was unconscious for 11 hours. He is now, however, progressing satisfactorily. If he does pull through, he will probably be the only person who can boast of having received a 10,000-volt shock and survived.

LIEGE, BELGIUM. HENRI PIEPER.

Combined Telegraph and Telephone Service.

To the Editors of Electrical World and Engineer:

Sirs.—The suggestive editorial comments on "The Telephone and Telegraph," published in your issue of Dec. 7, deserves the careful consideration of all who are interested in the development of long-distance communication, especially of those who are directly engaged in the telephone business. Long-distance lines are necessarily expensive, both in construction and maintenance, and when restricted to telephone business they are practically idle during more than half of every 24 hours. To make them remunerative the charges for communications must be high. The line can only carry messages at the speed of conversation, and an average of 60 words a minute during the hours of use is doubtless the full measure of its capacity.

The telephone is only useful for immediate and direct intercourse. It has been advantageously used in connection with the telegraph, but never as a substitute therefor. In Europe, and to a less extent in this country, messages are telephoned to telegraph offices for further transmission. But with us the combination is not much in favor. During the past summer the writer had occasion to send a 10-word message to a point in New York State where there was a telephone connection with a railway telegraph station. The charge for the telegram was 25 cents, and the telephone charge was 20 cents, making 45 cents to send 10 words 20 miles.

The telephone cannot encroach upon the telegraph, but there is no reason why the two should not be operated together on the same wires. The ideal combination would be high-speed, automatic machine telegraphy, carrying letter-telegrams of 100 words and upward at cheap rates, working on long-distance telephone lines. By this means long-distance telephone charges could be greatly reduced.

So long as it is necessary to make the telephone earn dividends on large capital investments in plants which are idle 16 hours every day, the high rates must be maintained. But if the costs are shared by the high-speed telegraph operated, for example, on the Delany system, the long-distance charges could be reduced 50 or perhaps 80 per cent. It is a safe prediction that either telephone companies will enter the telegraph field or else independent high-speed telegraph interests will establish new lines and enter the telephone field.

As regards the practicability of simultaneous telegraph and telephone operating, this has already been abundantly shown with the ordinary Morse key telegraphy. But this mode of operating does not offer any great inducement to long-distance telephone companies to enter into competition with existing telegraph companies. With high-speed automatic working the conditions are radically different. High-speed operation enables one telephone circuit to carry an enormous amount of telegraph business, whereby, without any interference with the regular telephone work, the plant will yield much larger returns than the telephone is capable of earning at its highest possible development.

It may be mentioned in this connection that the Delany system is in regular daily operation over a telephone line of the Pennsylvania Railroad, without interfering with the telephone business.

NEW YORK. ROMYN HITCHCOCK.

Money Order Telephony.

To the Editors of Electrical World and Engineer:

Sirs.—With reference to your article, "A Telephone Money Order System," in your issue of Dec. 7, 1901, may I be permitted to add the following: In London, England, there is a system in vogue with the National Telephone Company by which money is charged various subscribers. This, at present, is used exclusively for the service of what are called trunk lines (these being post office lines, used for telephone communication for districts outside of London, extending to the provinces), and telegrams, for the use of either of which there is the extra charge referred to. Subscribers making use of these facilities have a sum of money on deposit with the telephone company.

At the end of the period, when the deposit is exhausted, the subscriber is rendered a statement, he not being allowed to overdraw to any great extent. This, while being exceedingly commodious to the subscriber, is easily kept track of by the company, although having to open an account for each subscriber paying in the deposit.

The writer would suggest that a system of such a nature could advantageously be adopted for a money order system. Subscribers making use of such a system could have a deposit account with the telephone company, and instruct them through their own instrument to pay to any particular person the required sum, giving them the time, the place and under what conditions. This, I think, could be worked successfully in conjunction with the post office.

LOUIS J. ABRAHAMS.

BRUCE MINES, ONTARIO, CAN.

Properties of Collector Rings.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Nov. 23 I note a very complete resume of the articles of M. Maurice Leblanc and of M. Bunet, relating to the properties of collector rings. As a subscriber to your journal, I beg to direct attention to the article of M. Maurice Latour in the issue of Nov. 23 of *L'Eclairage Electrique*. The researches of M. Latour antedated the above publications, and a French patent based upon them was applied for on Dec. 13, 1900, when application was also made for an American patent. The article referred to is a reply to M. Leblanc, and at the same time establishes M. Latour's priority over Mr. Heyland.

PARIS, FRANCE. H. ST. MARTIN.

[An abstract of the article above referred to appears in our issue of Dec. 14, page 996.—EDS.]

Pressure of Radiation.

To the Editors of Electrical World and Engineer:

Sirs.—The editorial note in your issue of Dec. 14, 1901, under the caption of "Pressure of Radiation," being a review of experiments made to determine the truth of the Maxwellian theory regarding the pressure exerted by radiant energy in the direction of its path, contains this clause, "At any considerable distance from the sun the attraction and repulsion become theoretically equal upon a spherical particle of matter about one-quarter of a micron in radius, or half a micron in diameter, that is to say, having a diameter about equl to the wave length of violet. *Segregated particles smaller than this would be pushed from the sun, while particles larger than this would be pulled towards it.*"

To the part italicized I wish to direct attention, as it appears to contain the gist of the reason why the tails of comets are directed

away from the sun. For, given a quantity of minute segregated particles surrounding a nucleus or nuclei, the sizes of the particles and nucleus being such that the sum of the gravitational attractions of the sun and nucleus upon the particles shall be less than the repulsive pressure of the sun's radiant energy upon the particles, we have a condition that will cause the surrounding particles to be directed from the sun, thus forming the tail.

This would also account for the condensed appearance of the tail near the head, for the particles would there be moving slowly, owing to the retarding effect of the gravitational attraction of the sun and nucleus or nuclei, while as the particles moved towards the outer end of the tail, they would separate more and more, their speed increasing until it attained the velocity of light, or they fell under the influence of some celestial body.

The loss of the tail of a comet would be accounted for under this theory by the disappearance of the minute particles surrounding the nucleus, the same having been dissipated by the action of the sun's radiant energy; hence a tailless comet would be one consisting only of a comparative large mass or masses, having no surrounding envelope of finely divided matter. If the above theory is true the tails of comets should progressively diminish.

Baltimore, Md. J. W. Darley, Jr.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Electric Railway Motor Performance.—Hanchett.—This subject is treated by a preliminary discussion of the ordinary curves used in displaying the properties of an electric railway motor under all conditions of load, and showing how the various curves may be checked on each other and how, when the curves of torque and speed are given, the remaining curves can be computed therefrom. He then takes up the problem of determining the heating of electric railway motors under practical load conditions, and proposes a new method which be believes to be more accurate than any heretofore suggested. This method is briefly as follows: The heating inertia capacity of the motor is experimentally determined and the quantity C, which represents the amount of heat in kw-hours required to bring the motor to a certain limiting temperature, is definitely known. The radiating rate R at this temperature in kw-hours, is also made determinate, and it is assumed that $C \div R$ represents a constant which, when multiplied by the heat in the motor at any given time, will give the rate of radiation at that time. This proposition is true, if the rate of radiation is proportional to the temperature, which is also assumed to be proportional to the amount of contained heat in the motor. This amount of heat is readily determined at any given time by integrating a loss curve with reference to time and dividing by the elapsed time, subject if necessary to certain corrections. If the contained heat in the motor is known, multiplying by the constant will give the rate of radiation, and if the motor is to ascend a grade where it will be overloaded, that is to say, where the heat given to the motor is greater than the maximum rate of radiation, the difference between the contained heat and the total heat capacity represents a reserve which must not be exceeded. Therefore, dividing this reserve heat capacity by an average rate of radiation, which is mathematically determined, by the given data, will give the time that the motor will operate under this overload before reaching limited temperature. He suggests empirical modifications of the formulæ and methods of testing whereby this system of measurement can be developed and refined.—*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

Theory of Commutation.—Pichelmayer.—Girault, Fischer-Hinnen and Arnold have given the mathematical condition for sparkless commutation in commutating machines. He shows that this condition can be expressed simply as follows. The mean e. m. f. of self-induction of the short-circuited armature coil must be smaller than the volts lost at a brush. He then gives a correction of a method of Parshall and Hobart for calculating the reactance voltage.—*Elek. Zeit.*, Nov. 21.

Rotary Converters.—McAllister.—An article on polyphase rotary converters. The author states that the operation of a rotary converter is in general much more satisfactory than that of a corresponding direct-current generator, due to several causes: (1) Absence of field distortion; the rotary is both a generator and a motor. As a generator the armature current tends to distort the field in a direction opposite to the distortion as a motor. The effects of the armature reactions, therefore, neutralize each other, and since there is no shifting of the field, the point of commutation does not vary with the load, and sparkless commutation results. (2) Lessened friction loss. (3) Greater output from same armature. Since the load current at portions of each revolution feeds directly from the alternating-current side without traversing the whole winding, as must be the case with a generator, the effective armature resistance is less than it is for the same armature used in a generator.—*Am. Elec.*, Dec.

REFERENCES.

Three-Phase Induction Motor.—Weisshaar.—A mathematical article in which he develops some analytical equations for the three-phase induction motor, from the well-known diagram. He also gives some numerical examples to show the practicability of the analytical method.—*Elek. Zeit.*, Nov. 14.

Some Brush Arc-Light Dynamo Troubles.—Hanlon.—Considering the numer of years since its introduction, the author is surprised that no machine has been designed to satisfactorily take the place of the old Brush open-coil series arc-light dynamo. For hard wear and tear and severe usage, he claims that this old machine, designed in the early days of electric lighting, has not been surpassed or equaled. He enumerates a number of troubles which he met with in his experience with the machine, and gives their causes and remedies. —*Am. Elec.*, Dec.

One of the Old-Timers.—Weeks.—A short article illustrating one of the relics of the early days of electrical engineering, still doing service as a motor in a bicycle repair shop in Niagara Falls, N. Y. The relic is one of the earliest types of Brush arc-light machines, and has required no repairs since it has been built, other than the rewinding of an armature bobbin.—*Am. Elec.*, Dec.

Theory of Induction Motors.—Meller.—A rotary magnetic field, similar to that produced by the primaries of a polyphase induction motor, can be obtained by rotating a coil carrying a constant direct current. From this he explains the ordinary formulas for starting torque, lag, etc., of induction motors, also their use as frequency changers.—*Ass. Ing. El. Liege*, July 6; briefly abstracted in *Science Abstracts*, Nov.

Operation of Alternators in Parallel.—Darrow.—He states that when his company recently wished to install some alternators and engines, the manufacturers of each suggested specifications for the other which were not harmonious. He is in favor of the adoption of a common ground upon which the manufacturers of engines and generators can meet, as he believes that there should be no difficulty in reaching such a position.—*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

Lights and Lighting.

Crawford-Voelker Incandescent Lamp.—Maguire.—An illustrated article on a new incandescent lamp. The inventor of the Crawford-Voelker lamp claims to have discovered a method of effecting chemical union between several rare metals or earths and carbon, thereby being enabled to produce "for the first time a true carbide filament." The filaments made under the new process possess a higher specific resistance than carbon filaments, seem to disintegrate much more slowly, and are practically uniform in their resistance. It is stated that 500-volt lamps made by the new process do not seem to possess the same delicacy as the ordinary commercitl type of 200-volt lamps. A feature of the new lamp bulb is that it is bifurcated at the end, the purpose being to insulate the two ends of the filament. Preece has shown long ago that as the voltage applied to

incandescent lamps increases, a current flows through the exhausted space between the heels of the filament without passing through the filament at all, which simply wastes energy. Numerous tests with the new lamp are said to have shown that the life of the filament is greatly enhanced by this division of the globe. For light voltages it is claimed to be essential. In the new commercial lamp the carbide of titanium is used, but the carbides of other rare earths also give satisfactory results. Abstracts are given of a report of Holden who has made a 1000-hour test of the new lamp. He tested 50 lamps; 11 broke in the first 500 hours. Of these the average life would be about 350 hours. During the second 500 hours 15 lamps broke. Their average life was 762 hours. Twenty-four lamps did not break while burning for 1000 hours. At the beginning of the test the lamps had an efficiency of 2.535 watts per candle. At the end of 500 hours it was 2.845, and after 1000 hours 3.35 watts per candle.—Lond. *Elec. Rev.*, Dec. 6.

POWER.

Refuse Destructors.—GOODRICH.—A very long and well illustrated article on "Town refuse in Great Britain, its fuel value for steam raising." He claims that to-day British refuse destructors represent the world's best practice in this field of engineering, and that America and Continental Europe are far behind. He describes the following British destructors: Fryer, with Boulnois, Wood & Brodie's combination; Warner, Baker, Meldrum, Horsfall, Heenan, Mason, Beaman & Deas. In a table (in which some of the column headings are carelessly stated) he gives the comparative results from six distinct types of destructors in 12 Lancashire towns. The ihp (hour?) produced per ton of refuse on a basis of 20 lbs. of steam per ihp (hour?) varies between 60 and 218. The "evaporation per pound of refuse" for most of them is between about 1.5 and 2. He claims that while there is wide difference in the results, this difference is due to the type of destructor in use, and not by reason of any serious difference between the qualities of the refuse.—*Cassier's Mag.*, Dec.

REFERENCES.

The Use of Zinc in Boilers.—DOUGLASS.—A discussion of the placing of zinc in boilers in order to prevent the destruction of the plates and tubes from the action of feed-water containing elements of a corrosive nature. The author states that as a preventive to the formation of scale, zinc is of no particular value.—*Am. Elec.*, Dec.

Brake Magnets for Electric Cranes.—EHNERT.—A brief illustrated article on the calculation of the brake electromagnet for electric cranes.—*Elek. Anz.*, Dec. 5.

TRACTION.

Electric Traction Service Without Track.—SCHIEMANN.—An illustrated article on an installation of a regular traction service without track, the current being supplied from a pair of overhead wires. This he recommends especially where there is no great traffic, or as a preliminary installation for a future regular tramway. While in the Lombard-Gerin system shown at the Paris Exposition, and for connection between the city and railroad depot of Eberswalde, a small, peculiar electrically driven carriage runs on the two overhead wires, and is always a little ahead of the car below, he describes an installation near Dresden, Germany, in which the car has two trolley poles, which take off the current from the overhead wires by means of a sliding contact device, which can be turned around a vertical and horizontal axle. The arrangement is so made that the car can turn out; but the degree of turning out is much more limited than with the Lombard-Gerin system. When two cars, running in opposite directions, meet one another, the one takes off its trolley poles from the overhead wires, and the other passes by. The system is said to work quite satisfactory. From the results of three months of service, it appears that on the line the specific consumption of current is only twice that of a tramway with rails. This larger cost of current is in this case only about a tenth of the amount of interest, amortisation, and repair of the cost of construction of a track-mile. But this is correct only when the traffic is small. For frequent traffic a tramway with rails will always be cheaper.—*Elek. Zeit.*, Nov. 21.

Milford, Holliston & Framingham Street Railway.—This company has more than doubled its mileage during the present year, and expects to have its enlarged system in operation in a few weeks. A year ago a new management took control and has thoroughly reconstructed the road, besides making the extensive additions. With the town of Milford as the center, the system radiates on all sides but to the southeast. Two parks, one owned and operated by the company, are located on the road sufficiently near opposite extremities so as not to interfere with each other's business. The power station of the entire system is in Milford. It is being greatly enlarged by the addition of a 600-kw Westinghouse railway generator. The present equipment of the plant consists of two generators of 225 kw and 325 kw capacity, respectively, direct coupled to simple engines made by the Slater Engine Company. The entire electric lighting for Milford and the nearest adjoining town, is supplied by two 125-kw alternators made by the Stanley Electric Manufacturing Co., which are installed in the railway company's power station, and supply current at 66 cycles per second. This department is entirely distinct from the railway work, switchboards being separated by considerable space and a separate company controlling the distribution and sale of current. There will be three sub-stations. Two are storage battery stations, having a capacity of 240 amperes, situated at convenient distribution centers. The third is a rotary converter sub-station, which is situated on a separate branch and used in connection with a rotary conventer in the main power station, receiving current from the regular railway circuits. These two rotaries are of 150 kw capacity each. The transmission line between the two rotaries is 10,000-volt, three-phase circuit, for which aluminum wire is used. Five snowplows are owned by the company, and two more have been contracted for. One of these plows has two rotary fans placed near the rails. It was in use last winter and gave excellent results. Air brakes are used on all the large cars. A complete telephone system has been installed, the road being a single track line with turnouts at long intervals. The road is built in the most up-to-date manner, double overhead trolley wire being used to obviate the necessity of switches at turnouts, and the track being laid in accordance to steam railroad practice where the company's own right of way is used. This occurs for a large part of the new construction.—*St. R'y Jour.*, Dec. 7.

Shallow Underground Tramway Schemes.—Extracts of a report by Baker and Rider on the construction and working of the Boston subway and on the rapid transit subway now under construction in New York, with the proposal to introduce shallow underground tramways in London. They think that two important objects would thus be gained; a method of linking up existing tramways by taking surface cars underground through congested and prohibited areas, and a provision for pipes, cables, wires, etc., which would obviate the continual breaking up of the streets. They believe that shallow subways, as in Boston and New York, are in many respects preferable to deep level railways. The absence of elevators and the ready access from the street to the stations, and vice versa, by means of short stairways, render them particularly useful to those who wish only to ride short distances. The ideal form of transit is thought to be the one proposed in New York, viz., a subway, easy of access from the street, catering for express and local traffic.—Lond. *Elec.*, Dec. 6.

Operation of the Union Traction Company's Lines in Indiana.—A description of a high-speed interurban line operating 153 miles of track. The cars are dispatched by telephone and connection is made with the telephone wires at each turn out. The connection is made by the motorman without leaving the car. In addition to the telephone connections at each turnout there is a telephone connection box every half mile. The maximum speeds are as high as 60 miles per hour. The trolley wheels used are 6 inches in diameter, and at full speed the current required is 150 amperes, although during acceleration the motors often take 300 to 350 amperes. Some of the cars are equipped with two and some with four motors. For removing the trucks, the company uses a pneumatic hoist which raises the car body and allows the trucks to be run out from under the car. The cars are cleaned by compressed air, by means of the nozzles. A table of operating cost is given. Power is distributed at 15,000 volts by means of the three-phase system. A portable sub-station is an important feature of the equipment. This is contained in a closed car, which carries a 250-kw rotary converter and three transformers. It can be run to any sub-station on the line and connected with the apparatus there. The article is profusely illustrated.—*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

REFERENCES.

Sacramento.—A description of the traction system. The population of this city is 29,000, and 21 cars are run on ordinary schedule. The company sells 22 tickets for a dollar, and the tickets are made

of aluminum, about the size of a nickel. Cheap water power is used. —*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

Loop Terminals for Elevated Railways.—An argument in favor of a terminal in which the trains discharge and receive passengers from separate platforms instead of from the same platform. Several instances are cited to prove the case.—*St. R'y Jour.*, Dec. 7, and Int. Ed., Dec.

Installations. Systems and Appliances.

British Electric Schemes.—An editorial on the 1902 parliamentary session, giving a summary of the private bills which will be brought before the British Parliament next session. These bills relate to an extremely large number of new electric traction schemes. All the "tube" railway projects for London will also come up for consideration. If all these projects were realized, there would be, together with the existing lines, nearly 180 miles of deep level railway in London. A bill, which is hoped to be the forerunner of many, to convert main railway lines from steam to electric driving, is one promoted by the London, Tilbury & Southend Railway. An underground railway is proposed to tunnel under the Tyne and connect Tynemouth with South Shields. A large number of private bills relate to electric lighting and power supply. Two municipalities are buying out the companies which are now operating in their towns. Several municipalities ask for permission to supply electric power "in bulk," outside their own areas.—Lond. *Elec.*, Dec. 6.

Isolated Plant.—An illustrated article on the reconstruction of the isolated plant of a large department store in Chicago. The old plant contained an engine connected to a countershaft by a rope drive; two 50-kw generators were belted from the countershaft. The countershaft and old generators have been taken out and there have been installed a direct connected 100-kw generator, and another generator of equal capacity to be operated by means of the old engine and rope drive. The principal load on the plant is for lighting, the building being wired for a straight 110-volt, two-wire service. There are 160 enclosed arc lamps of 5 amperes and 1200 cp, and 600 incandescent lamps of 16 cp.—*West. Elec.*, Dec. 7.

Electric Installation of a Laboratory.—A description of the electric installation of the chemical laboratory of the university of Bonn, Germany. High-tension, three-phase currents are obtained from the public supply main and transformed to 110 volts, for supplying the lamps and a 10-hp, three-phase motor, which drives a direct-current dynamo. To obtain the different voltages required for electro-chemical experiments, two storage batteries are provided, one of 60 cells and 158 ampere-hours capacity, the other of 14 cells and 24 ampere-hours. At any table in the laboratory pressures of 4, 8, 12 or 20 volts are available, and by means of rheostats other voltages may be obtained. Stirring apparatus are operated by small 8-volt machines. A diagram shows the arrangement of the switchboard and the total wiring.—*Elek. Zeit.*, Nov. 14.

References.

Regulations.—A reprint of the proposed revised regulations for electric installations, for voltages below 600. The subject is also discussed editorially.—*Elek. Zeit.*, Nov. 21.

Combined Traction and Lighting Switchboard.—An illustrated description of a standard type of board built by Ferranti for a combined 460-volt lighting and 400-volt traction system. The storage battery regulating switch is under the regulating table in front of the board. There are five generator panels and seven traction panels. The equipment of each panel is described.—*St. R'y Jour.*, Int. Ed., Dec.

Wires, Wiring and Conduits.

Reference.

Most Economical Cross-Section of Electric Conductors.—Rossander and Forsberg.—A mathematical article. They remark that W. Thomson's (Kelvin's) formula for calculating the most favorable cross-section of the conductor of an electric circuit is based upon assumptions which do not apply at all when the electric energy is generated by water power. They develop a new formula for this case, which is more complicated than Thomson's, as it contains two more constants.—*Teknisk Tidskrift;* translated into German in *Elek. Anz.*, Dec. 1.

Electro-Physics and Magnetism.

Electron Theory.—Oliver Lodge.—A brief editorial note on "modern views of electricity and matter." He reviews electrical phenomena from the electron point of view, and expresses the opinion that the electron hypothesis of the constitution of matter would be found to be capable of explaining apparently non-electrical properties such as rigidity. Atoms which at one time were regarded as hard spheres, and subsequently as vortex rings, of ether, are now to be thought of as congeries of electrons—each a "sort of solar system in miniature." Thus the fundamental element in matter, might, after all, prove to be electricity. There is also a brief note on a recent address by Lodge, on self-induction. He expressed the startling view that self-induction is a truly mechanical inertia; in fact, the only inertia that exists, the properties of matter having to be explained in terms of electricity.—Lond. *Elec.*, Dec. 6.

Action of Radium Rays Upon Bacteria.—Aschkinass and Caspari.—A paper on the therapeutic value of the action of Becquerel rays in certain diseases. They used the method of Buchner for demonstrating the bactericidal action of light. A layer of agar-agar containing germs of micrococcus prodigiosus was poured into a flat glass dish and allowed to set. The dish had black letters painted or stuck on its cover and light was admitted from above. After a couple of days the portion of the nutritive medium below the letters was colored deep red by colonies of the micrococcus, while the exposed portions were quite clear. On exposing a similar culture to a radium preparation contained in an aluminum capsule no effect was produced. But an exposure to the rays from the bare preparation killed the germs very effectively in about three hours. They made sure that the effect was nither due to phosphorescence nor to ionized air, nor to bromide vapor. This shows that the effective rays are those which are more easily absorbed, and the physical distinction between the two classes of radium rays is thus emphasized by a marked physiological difference.—*Ann. der Physik.*, No. 11; abstracted in Lond. *Elec.*, Nov. 22.

Electro-Chemistry and Batteries.

Electro-Chemical Industry in Germany.—J. B. C. Kershaw.—The fourth of his series of articles on the electro-chemical and electro-metallurgical industry, dealing with the progress in Germany. There are nine electrolytic copper refineries in Germany, but their output is not large, and the scarcity of raw copper suitable for refining by the electrolytic process checks all hopes of any expansion of the industry. At Schladern, the Elmore process for making tubes and sheets is worked with better financial results than in England, and the refinery is said to have 1000 hp available for its operations. At Papenberg, the Hoepfner process for extracting copper from its ores is worked in conjunction with a nickel process, cuprous chloride being used as the leaching agent. This installation is comparatively recent, and it is too early yet to say that the process has been demonstrated to be a success. The Siemens & Halske copper process did not yield satisfactory results on practical trial, and the Marchese copper extraction process, when tried at Stolberg, also proved a costly failure. In the two factories at Neuhausen and Rheinfelden, owned by the Neuhausen Company, there are 9000 hp available for the manufacture of aluminum, but the whole of this is not devoted to the production of aluminum. Reliable data are not available, but the company is financially one of the most successful electro-metallurgical companies in Europe, the dividend paid on its capital of $3,077,000 usually ranging from 10 to 13 per cent. The German alkali plants have directed their energy to supply all the requirements of the home market for potash salts, the bleaching powder being regarded as a bye-product. Several plants use the "Electron" process which is unpatented and a secret; it is believed to be a diaphragm process. The Castner cell is used in one plant where 1500 hp are available. The eight German electrolytic alkali works have over 14,000 hp available for the manufacture of caustic alkalies and bleaching powder. Gold and silver bullion refineries are in operation at Hamburg, Frankfort and Pforgheim. The process used resembles in principle that for refining crude copper. The gold or silver bullion is used as an anode in a suitable electrolyte, with thin plates of pure metal as cathode. On the passage of the current the silver or gold is deposited at the cathode, while the impurities either remain in solution or collect as the anode "sludge." Since gold bullion often contains palladium and platinum as impurities, and these metals can be separated by comparatively easy methods from the "sludge," the electrolytic bul-

lion refining process offers many advantages. The value of the output of the Hamburg and Frankfort refineries in 1900 was $12,500,000. The hypochlorite cells most widely used in Germany are those of Kellner, Vogelsang and Oettel. They are chiefly used in the textile factories of Saxony. Over 1500 hp are now utilized for this purpose. Nickel is refined by an electrolytic process at Siegen, and the same metal is extracted from the Caledonian ore by the Hoepfner process at Papenberg. It is, however, too early yet to consider that the success of this process has been demonstrated. In 1900 the Papenberg works were stated to be producing one and a half tons of nickel per day. The larger German color works are known to use electrolytic methods for reduction and oxydation purposes in the manufacture of dyes and other organic products, but no details of these methods are allowed to be made public.—*Elec. Rev.*, Dec. 14.

Secondary Reactions in Electrolysis.—J. W. RICHARDS.—A Franklin Institute paper. He defines primary electrolysis as the action of the current whereby it directs the ions towards the electrodes and liberates them as ions at the electrodes; secondary reactions are such reactions of the ions upon themselves, or the electrodes, or the electrolyte, whereby substances other than the ions come into existence at the electrodes. The work done during electrolysis is of two kinds: First, the work done in overcoming the ohmic resistance of the bath; second, the work done which is rendered latent as chemical energy. The latter energy includes not only the chemical energy expended in the primary electrolysis, but also the energy expended in the secondary reaction. The total chemical work of the current is represented by that required to transform the original ingredients into the compounds of substances which come into existence by the electrolysis, whether of primary or secondary origin. He discusses the calculation of the voltage required for an electro-chemical reaction, from the thermo-chemical data. He classifies the secondary reactions into the following four types: The ions polymerize into more complex forms; the ions decompose or dissociate into simpler forms; the ions react upon the electrodes; the ions react upon the electrolyte. The action at the cathode is a reducing action, at the anode an oxidizing action. Instead of oxidizing in this general sense he recommends calling it "perducing," the reverse of "reducing." A large number of examples are given, when the product at the electrodes is either a gas, or a liquid, or a solid soluble or not in the electrolyte. For all these cases the equations are given and the voltage is calculated from the thermo-chemical data. Among the processes discussed are Salom's lead reduction, by using lead sulphide as cathode in an acid solution; the Castner cell for producing caustic soda, and many others.—*Jour. Frank. Inst.*, Sept.

Losses of Energy in Storage Batteries.—HOPKINSON.—The conclusion of his article. While diffusion must be an important factor in the dissipation of energy it need not necessarily be the only cause. He thinks it is possible that there is secondary chemical action in the plates themselves which takes time to perform. When there is gas evolution, it, of course, causes a loss of energy. It has often been remarked that the same number of ampere-hours can be gotten into a battery with a less expenditure of energy and in a less time if the charging be done at a constant potential than if it be done at a constant current. He found that when a Tudor cell was discharged for two hours at a current of 2.4 amperes, and the current then reversed to charge, gas began to be given off in considerable quantities after half an hour, and there was a considerable rise in the potential. In such a case not only is the energy due to the evolution of gas lost, but the electro-chemical value of the current is lost also. By keeping the potential down, the evolution of gas may be stopped to a great extent, and both the waste of energy and of current may be prevented, though in the latter parts of the charge the current must necessarily be small.—Lond. *Elec.*, Dec. 6.

Manufacture of Carbon Electrodes.—STRAUSS.—A description of the process used for manufacturing and testing carbon electrodes at the factory of the Société des Carbures Metalliques, which owns several calcium carbide plants. The raw materials are retort carbon, petroleum coke and coal tar. The carbon is first crushed into a powder. It is then mixed in steam-jacketed apparatus with the necessary proportion of tar, and ground under edge runners. As it leaves the grinding machines the mixture forms a thin, flat cake, hard, but flexible, and is then ready to be moulded into shape. There are two methods commonly adopted for forming the electrodes: By simple pressure, or by extrusion, i. e., forcing the material through a drawplate. The latter method requires more costly apparatus, but gives a more uniform product and is used at that plant. The electric properties of carbon electrodes vary greatly, according to the nature of the raw materials used, and are also affected by the manufacturing process.—Lond. *Elec. Rev.*, Dec. 6.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing the Magnetic Qualities of Materials in Bulk.—DRYSDALE.—An illustrated paper read before the Brit. Inst. of Elec. Eng. on a new and very simple permeameter for testing the magnetic qualities of materials in bulk. He has adopted the plan in commercial testing of making both the specimen and the greater part of the return path from the bulk of the material tested. A drill of a special form is used which cuts a circular hole in the specimen, conical at the top, leaving a pin in the center of it. In the usual form of instrument this hole is ⅜ inch in diameter and ⅝ inch deep, and the diameter of the pin is 0.1 inch, but these dimensions could be considerably reduced if necessary. The testing arrangement consists simply of a soft iron plug, carrying a bobbin, on which are wound two circuits, a magnetizing coil and a search coil. The plug is split and is turned slightly conical on its outside surface, while the drill cuts the cone of the same angle as that of the plug. It will be seen from the adjoining figure that on drilling the hole and inserting the plug, a perfect miniature permeameter is produced, having an exceedingly good magnetic circuit, and in which either the permeability, retentivity, or hysteresis can be determined by ordinary methods. The adjoining diagram shows the connections which are mostly employed. The magnetizing coil *M C* of the plug is supplied with current from a battery *B*, through a regulating resistance *R* and ammeter G_1 and a reversing switch *R S*. Connection is also made from the search coil *C C* to a ballistic galvanometer G_2. On making, breaking, and reversing the circuit, deflections are obtained on the galvanometer G_2, which are proportional to the magnetism of the specimen. In order to make the instruments direct reading it is easy to provide a scale for the galvanometer G_1 so that it reads the value of *H*. In the same way a scale is provided for G_2 reading the values of *B* directly. The permeability is then obtained, if necessary, by dividing *B* by *H;* but it is generally sufficient to compare the values of *B* obtained with the curve of some satisfactory specimen. In ordinary commercial testing of castings, etc., it would probably be sufficient to know the value

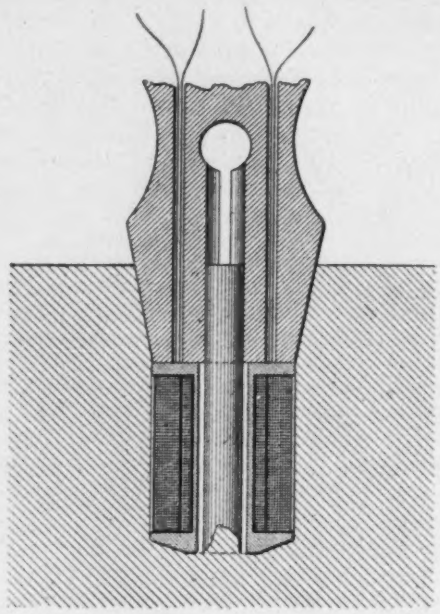


FIG. 1.—SECTION THROUGH PLUG AND SPECIMEN.

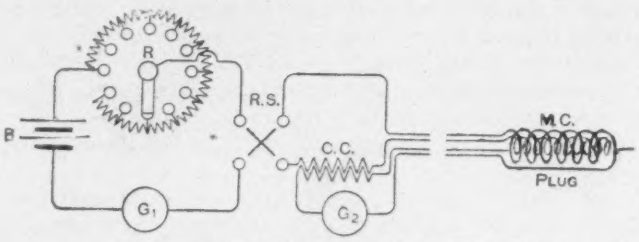


FIG. 2.—CONNECTIONS FOR BALLISTIC TEST.

of the permeability for one value of the magnetizing force. In this case the arrangement may be further simplified by withdrawing the resistance R and galvanometer G_1 and simply arranging the cells to give one definite current. The divisions on the galvanometer G_2 may then be marked directly with values of the permeability. He also describes a zero-reading method and a direct deflecting method, but he prefers the simple ballistic test, as the connections are more simple. Commercial forms of the apparatus are described and details of construction and calibration are given. On examination the accuracy has been found to be most satisfactory, so much so as to be quite equal to that of other commercial methods.—Lond. *Elec.*, Dec. 6. The discussion which followed is abstracted in Lond. *Elec. Rev.*, Dec. 6.

Hysteresis Measurements.—Finzi.—A description of a method of measurement, based on the assumption that, after magnetic saturation, the hysteresis of soft iron is proportional to its coercive force. The specimen may be of any dimensions provided it can pass into the magnetizing solenoid. It is magnetized till practically saturated, and the current diminished to zero and then reversed. The field required to demagnetize the iron is measured on an ammeter, the demagnetization being ascertained by a magnetoscope. For soft iron the hysteresis coefficient in Steinmetz's formula is equal to the coercive force multiplied by 0.00135.—*Elettricita*, June 8; abstracted in *Science Abstracts*, Nov.

REFERENCE.

Measuring the Insulating Resistance.—Strecker.—An illustrated paper, read before the Electro-Technical Society of Berlin. He describes in detail the methods used by the government telegraph office for determining the insulation resistance of the telegraph cables connecting the larger cities of Germany. There is nothing essentially new in the method, but certain simplifications have been introduced, more especially a slide rule for this particular purpose, which enable one to complete calculations of the tests in one-tenth the time required before.—*Elek Zeit.*, Nov. 14.

Telegraphy. Telephony and Signals.

Electro-Capillary Relay.—A description of a relay, devised by Orling and Armstrong, which is said to be sensitive to 0.003 volt. It is based on the same principle as the capillary electrometer. The relay consists of an inverted U-tube containing mercury. One end of this tube is immersed in a mercury reservoir, and the other end, which is drawn to a fine point, reducing the bore to something in the order of 0.004 inch, dips into a bath of dilute acid. Just beneath this point is one end of a lever whose middle rests on a knife edge, the other end of the lever moving between the two contacts of the local circuit. The height of the mercury in the reservoir is such that its pressure is just balanced by the capillary force at the point of the tube. The current is led in at the top of the bend of the U-tube, and out at the bath of dilute acid. As soon as a small current passes, the capillary force is diminished, and the mercury begins to drop from the tube, ceasing again as soon as the current ceases. The mercury falling on the end of the lever tips it up and closes the local circuit.—Lond. *Elec.*, Dec. 6; with illustration in Lond. *Eng'ing*, Dec. 6.

REFERENCES.

Hotel Telephone Exchanges in Chicago.—An illustrated article on the establishment in Chicago of branch exchanges in hotels, affording interior communication and also giving every guest the advantage of talking from his own room to any instrument in the city system or the long-distance lines. Five Chicago hotels are thus equipped. Two large ones are served from one exchange, which is said to supply the largest hotel-telephone system in the United States, and is described in detail. The central battery, automatic signaling system is used.—*West. Elec.*, Dec. 14.

Berlin Telephone Exchange.—Kroesing.—A very long and well illustrated description in detail of the telephone system installed by Siemens & Halske in an exchange in Berlin.—*Elek. Zeit.*, Oct. 31, Nov. 7, 14.

Telephone Exchange Notes.—Henry.—A short article containing a number of practical and useful suggestions on telephone exchange equipment.—*Am. Elec.*, Dec.

Miscellaneous.

REFERENCES.

Rowland.—The full address held by Mendenhall, at the Memorial Meeting at the Johns Hopkins University on the life and work of Henry Augustus Rowland.—*Science*, Dec. 6.

German Manufacturing Plant.—A short illustrated description of the works of Lahmeyer & Co. at Frankfort.—*St. R'y Jour.*, Int. Ed., Dec.

New Books.

Lessons in Practical Electricity. Principles, Experiments and Arithmetical Problems. An Elementary Text-Book. By C. Walton Swoope. New York: D. Van Nostrand Company. 462 pages, 385 illustrations. Price, $2.

This work is based upon a similar one prepared and printed by the author several years ago for use in the Spring Garden Institute, Philadelphia, in connection with the author's evening classes in practical electricity. As a text-book for such work, and as an elementary treatise written from the practical standpoint, this book serves an admirable purpose.

The first seven chapters treat of the fundamental principles of electricity and magnetism, following which are chapters on all the various practical applications of these sciences. The information conveyed is made as practical in character as the subjects will admit. Following the development of each subject is one or more numerical problems, and whenever practicable instructions are given for the performance of experiments illustrating the text, and employing apparatus easily made by the student. Much practical data are scattered throughout the book. In the section on resistance, for example, is given a useful table of the resistances of commercial apparatus, including ammeters and voltmeters, primary batteries, telegraphic and telephonic apparatus, dynamos and motors, transformerrs and incandescent lamps. At the end of each chapter is a series of questions by means of which the student can test his understanding of what he has read. Thirty-two tables, principally of practical application, are given in an appendix. A pocket in the back cover contains two folded plates, one of which contains a diagram of connections of a direct-curent switchboard, and the other a car wiring diagram for a K-10 controller with two motors.

This book can be recommended with confidence to those beginning the self-study of electricity, and particularly to those who wish to confine their knowledge of the science to its more practical aspects. It should also serve as an excellent text-book in teaching evening classes.

Schaltungsarten und Betriebsvorschriften. By Alfred Kistner. Berlin: Julius Springer. 210 pages, 81 illustrations.. Price, 4 marks.

This clear and concise little volume on storage battery switchboards gives the various schemes of interconnection of the line, battery and machine that have been found commercially successful. As the book is intended chiefly for the use of isolated plant engineers and switchboard attendants, pains have been taken to present the subject in a readily comprehensible and not too technical manner.

The plan of the book is good, there being first a very short section on dynamos, pointing out which types are suitable for battery charging and why, and a rather more extended mention of the various switches, automatics and other controlling devices found on battery boards with statements as to their functions. Then comes a section pointing out that it is the e. m. f. variation of accumulators at different stages of change that necessitates much of the switchboard complication and showing how to figure the number of end cells needed, etc. After this follows the main subject matter; that is, an explanation of the various standard ways of connecting up battery plants. Four general types of installation are named as follows: Plants with shunt dynamos and simple single end cell switches; plants with shunt dynamos and double end cells switches; plants where boosters are used, and plants in which the battery is divided into two groups which are coupled in parallel in charging, and in series when discharging.

Of course, under each heading alternative groupings are given, the whole mounting up to seventeen different plans, each suited to meet some special set of conditions. A valuable feature is the clear full page diagram accompanying each description. In addition to this there are directions for operating installations of each of the several kinds which, while necessitating considerable repetition, nevertheless should enhance very materially the value of the work as a reference book to those for whose use it is intended.

No attempt has been made to bring in the elaborate and heavy apparatus needed where storage batteries are in use in large central

stations, nor are three or five-wire plants mentioned. There is further a gratifying absence of padding with descriptions of dynamos and batteries, and the care of each, which matters while strictly speaking are foreign to the scope of the volume are still closely enough allied to it to present temptation.

BOOKS RECEIVED.

KALENDER FUR ELEKTROCHEMIKER. Sowie Technische Chemiker und Physiker fur das jahr 1902. VI. jahrgang. Mit einer Beilage. Von Dr. A. Neuberger. Berlin: M. Krayn. 555 pages, 21 illustrations. Beilage, 448 pages. Price, 4 marks.

GRUNDRISS DER ELEKTROTECHNIK. Von Heinrich Kratzert. II. thiel, 2 buch und 3 buch. 2 auflage. Leipzig und Wien: Franz Deuticke. 436 and 275 pages. Price, 10 marks and 6 marks.

ELECTRIC GAS LIGHTING. By H. S. Norrie. New York: Spon & Chamberlain. 101 pages, 57 illustrations. Price, cloth, 50 cents.

ENGINEERING EDUCATION.—Proceedings of the Society for the Promotion of Engineering Education. Buffalo Meeting, 1901. Vol. IX. New York: Engineering News Publishing Company. 348 pages, 4 illustrations. Price, $2.50.

VELOCITY DIAGRAMS. Their Construction and Their Uses. By Charles W. MacCord, A. M., Sc. D. New York: John Wiley & Sons. 116 pages, 83 illustrations. Price, cloth, $1.50.

Tests of Mechanical Stokers at the General Electric Company's Works at Schenectady.

BY WILLIAM R. RONEY.

THERE appeared in the Nov. 7 issue of the *Engineering News* an article, which consisted of extracts from the report of a series of tests made by Professor J. E. Denton and Mr. Geo. H. Barrus, representing the American Stoker Company, and Messrs. Deane & Main, Boston, representing the General Electric Company. Owing to the manner in which these extracts were presented by the *Engineering News*, and the absence of reference to several important facts connected with the tests, it seems to the writer that the article in question does not present the case in a manner equally fair to all parties concerned.

As stated in the report, these tests were conducted for the purpose of determinng whether the American Stoker Company had fulfilled certain guarantees in their contract with the General Electric Company. On account of a clause in the contract, in which the American Stoker Company guaranteed to "generate a *net* horse-power of steam as economically as the Roney stoker," the engineers decided to test one of the Babcock & Wilcox boilers equipped with the Roney stoker, which had been installed in 1898, and which had been in operation continuously, day and night, for over two and half years.

The position was taken by the engineers, that as the tests were to be conducted for the purpose of determining whether the American Stoker Company had fulfilled its guarantees, the manufacturers of the Roney stoker had no interest or part in the matter, their stokers having been accepted and paid for several years before. Under this ruling the Roney stoker was brought into a competitive test, in which the makers were not permitted to direct its operation, and were not represented, except by an erecting superintendent who was allowed to witness the final test, but not to give directions. One of the results of this ruling is shown in that part of the report regarding "Labor required for operating the stokers," where the report states that "in the Roney stokers, according to the practice of the fireman during the test there was a continual attention and exertion required, etc." This method of handling the stoker was contrary to the "instructions for operation," which are furnished with the Roney stoker, and was the result of inexperience, the fireman having never fired on a test before. If the manufacturers had been permitted to direct the operation of the stoker, this unnecessary labor would have been avoided.

Under the paragraph, "Comparative Economy of the American Stoker and Roney Stoker," various costs of operation are summed up in the following table. In this table it seems rather illogical from an engineering standpoint to credit the American Stoker repair account with the excess over 5 per cent, which the makers, under their contract, assumed for a period of two years. The question of financial liability will not be apt to have much effect on the actual deterioration of the stoker.

As the report assumes that this table demonstrates that "the cost of steam is less with the American stoker than with the Roney Stoker," it is but fair to call attention to some facts not brought out in the report which bear on the other side of the question.

The principal item in the table is "Cost of Coal" per horse-power

Costs per hp per Year.	American Stokers. Repairs according to 3 mos. record on log book.	American Stokers. Repairs guaranteed in contract.	Roney Stokers.
Cost of coal	$34.95	$34.95	$35.76
Cost of repairs	0.77	0.12	0.48
Wages of fireman and helpers.	1.44	1.44	1.44
Interest and depreciation	0.38	0.38	0.38
	$37.54	$36.89	$38.06

per year. This is obtained by dividing the amount of water required per horse-power for 300 days of 24 hours each by the net evaporation from and at 212 degs. F. per pound of coal. This method of determining the efficiency of the stoker by means of the boiler performance is manifestly an improper one. The condition of the boiler or the arrangement of the heating surface may be such that its inability to properly absorb heat will neutralize the most perfect combustion obtainable in the furnace. If in these tests the boiler evaporation was to be assumed as the standard of stoker efficiency, the boilers should have been of the same type and the heating surface and settings in the same condition. The Babcock & Wilcox boiler and Roney stoker had been in use over two and a half years, and had never had the fire sides of the tubes cleaned, except by blowing from the outside, and the setting was more or less cracked, while the Stirling boiler with American stoker was new and recently put in service. A contract test was made some six months after this Babcock & Wilcox boiler and Roney stoker were put in service, at which an evaporation of 12.66 from and at 212 degs. per pound of combustible was obtained, exceeding the results obtained by either stoker in the series of tests under consideration. Substituting this evaporation for that obtained on June 18, 1901, when the boiler was old and dirty, would make the cost of coal required per horse-power per hour $34.08 instead of $35.76, as given in the above table. If the table be corrected to make the "Cost of Coal" correspond with what it was when the boiler was new and clean the "Cost per horse-power per year" of operating the Roney Stoker would be $36.40 per horse-power instead of $38.06, as given in the table and less than either of the amounts given as "cost of operating" the American stoker.

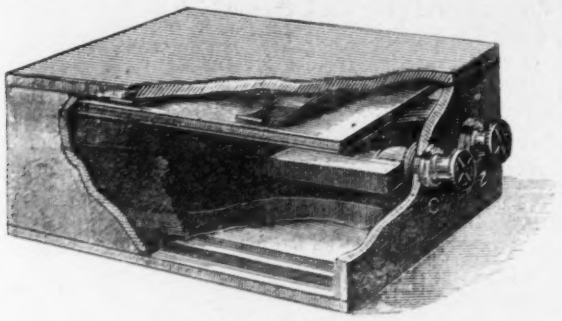
The "Cost of Repairs," namely, 48 cents per horse-power per year, is excessive on account of the fact that the draft of the Babcock & Wilcox boiler was only .15 to .16 of an inch in the furnace, due to insufficient chimney. These boilers and stokers are operated with natural draft and the poor draft caused high temperature in the ashpit and excessive repairs. The records of many large plants show that the cost of grate bar repairs for the Roney stoker with proper draft conditions should not exceed 12 cents per horse-power per year.

A stoker does not evaporate water. Its function is to burn coal, and the measure of its efficiency is the ability to produce good combustion, as shown by the analysis of the flue gases and not the amount of water evaporated per pound of coal by the boiler to which it is attached. The record of the analysis of flue gases from the Roney stoker shows an average of $\frac{C\,O_2}{14.2}$, $\frac{O}{4.67}$, $\frac{C\,O}{0.29}$. This is as good combustion as has ever been obtained, and the fact that the evaporation from and at 212 degs. F. per pound of coal by the Babcock & Wilcox boiler and Roney stoker was 11.169, instead of 11.7, as obtained when the same boiler was new and clean, simply shows that the difference is due to the fact that the boiler was not in condition to absorb the heat generated by the stoker. The heat balance given in the report shows that the Stirling boiler absorbed 77.1 per cent, and the Babcock & Wilcox boiler 72 per cent of the heat of combustion. Or, in other words, judged by the ability of the boilers to absorb heat, the Roney stoker was handicapped by a difference in boiler efficiency of 7 per cent. This is more than double the amount given in the table quoted above as the difference between the two stokers in "Cost of steam per horse-power per year," and completely reverses the statement in the report that "in point of relative economy the guarantee of the American Stoker Company is fulfilled." It is most important in comparing these tests, to remember that the boiler to which the Roney stoker was attached was old and

dirty, and that the combustion was of the best. In comparing the economy of the two stokers the operation of the boilers should have been eliminated and the efficiency of the stokers determined by their ability to produce good combustion. To be consistent, the experts should have considered the results of the tests from this standpoint. Had they done so their conclusions would obviously have been different.

Pile-Block Dry Battery.

The Imperial Electric Supplies, Limited, of London, is putting on the market a novel form of dry battery known as the pile-block dry battery, which was devised and patented by M. P. Germain, of Paris. It has been largely used in France by the Post Office authorities for telegraph purposes, and by the railway companies for their telegraphs and telephones. It is also much used for electric bells, and a special type has been largely adopted for ignition purposes in automobiles. The accompanying illustration shows clearly the construction of the battery, which is hermetically sealed in an oak case. The e. m. f. of



DRY BATTERY.

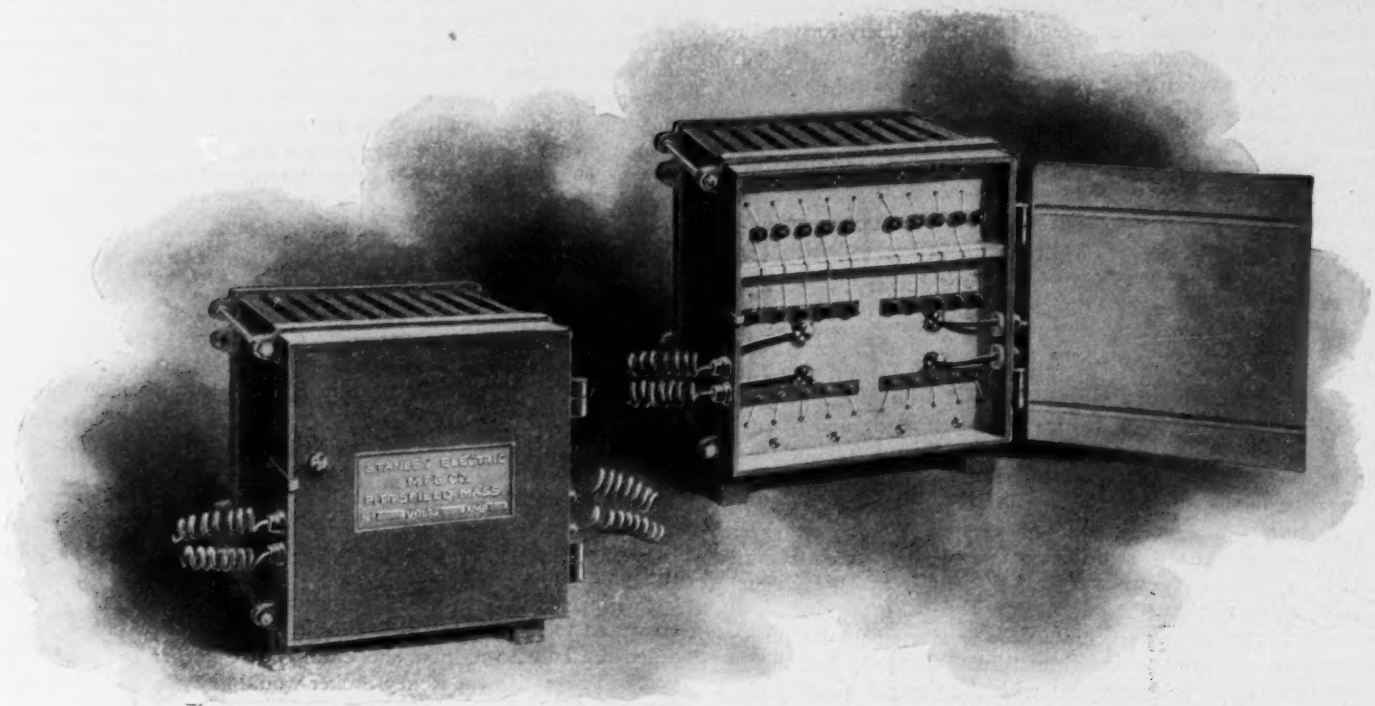
the battery is 1.6 volts, and its internal resistance is not only extremely low but remains low even when the battery is nearly exhausted.

Motor Condensers.

As it is well known, a condenser of proper capacity connected in multiple with the field coil of an alternating-current motor will supply the lagging component or magnetizing current—in other words, will neutralize the inductance of the field. Alternating-current motors so connected take current in proportion to their load substantially as direct-current motors do. The wattless currents, instead of flowing back to the generator and burdening the whole system, simply surge in the local circuit through the condensers.

Condensers were used for this purpose as early as ten years or more ago; in fact, coincident with the introduction of the Stanley-Kelly type of induction motor. The Stanley Electric Manufacturing Company has continuously manufactured such condensers, and recently having greatly enlarged its facilities in this line. The accompanying illustration shows two of the standard types. The standard sizes are made in sections contained in a tin box 12 inches by 10 inches by ¾ inch. For motor work these sections or slabs operate on 550 volts at common frequency. They are made in three sizes, approximately 3, 2.4 and 1.8 microfarads each, the same size tin box being used to contain either.

Special sections can be made to order of different capacity, or so sub-divided that by grouping different sub-divisions or sections a wide range of capacity can be secured, condensers being furnished within very close limits to any required capacity. Specially prepared paper and tinfoil are used, assembled in layers and treated in paraffine under a vacuum at the proper temperature to remove all moisture and gases. This treatment insures a perfect sealing of the paper and tinfoil, leaving no space for vibration of the parts or for a discharge to pass through the dialectic.



CONDENSERS ASSEMBLED.

For motor work the sections of S. K. C. condensers are assembled in a cast iron frame or case. Two standard sizes of the latter are provided, one to contain up to six sections, the other for as many as ten sections. An enclosed terminal and fuse box is located at one end of these cases, and it is intended that each section be separately fused. By combining groups of these cases the condenser capacity for various sizes of motors is obtained.

Switchboard Apparatus.

One of the largest types of switchboards made by the Kellogg Switchboard & Supply Company is shown herewith. The entire front, sides and back of the cabinet are of quartered oak, neatly paneled and beautifully polished, which presents a very striking appearance.

The front and rear panels are readily removable, being held in place by flush ring catches of highly polished brass. This construction makes access to all apparatus a very simple matter. The key shelf is three-ply and hinged. The plug shelf is covered with heavy belt leather to prevent wear of the plugs. The foot-rail is of brass and highly polished, which adds much to the general attractiveness of the board.

In designing this board it was the purpose of the company to produce one that would, by means of its superior construction and latest types of devices, overcome a number of objectionable features found in most boards, and at the same time make it very rapid in operation. It has a capacity of 300 magneto lines, and is equipped with the Kellogg combined mechanically self-restoring drop and jack, and is provided with lamp transfers.

In each end position is shown, just beneath the drops, the lamp

transfers, five in number, with a capacity of ten in each position. These are operated by 10 cells of Fuller battery. The object of these lamp transfers is to make rapid connections between subscribers whose lines terminate in a position not within easy reaching distance of the operator who receives the call. As an illustration, a subscriber asks the operator at the right for a number in the position on her extreme left. She immediately plugs into the transfer lamp, as shown in this cut, which lights her lamp, and the corresponding lamp in the position where the connection is desired. This being a signal for the second operator, she immediately plugs into the jack corresponding to this lamp, as shown, which being done extinguishes both lamps, and completes the circuit between the two operators, thus enabling the first operator to give the second one the subscriber's number, who makes the desired connection.

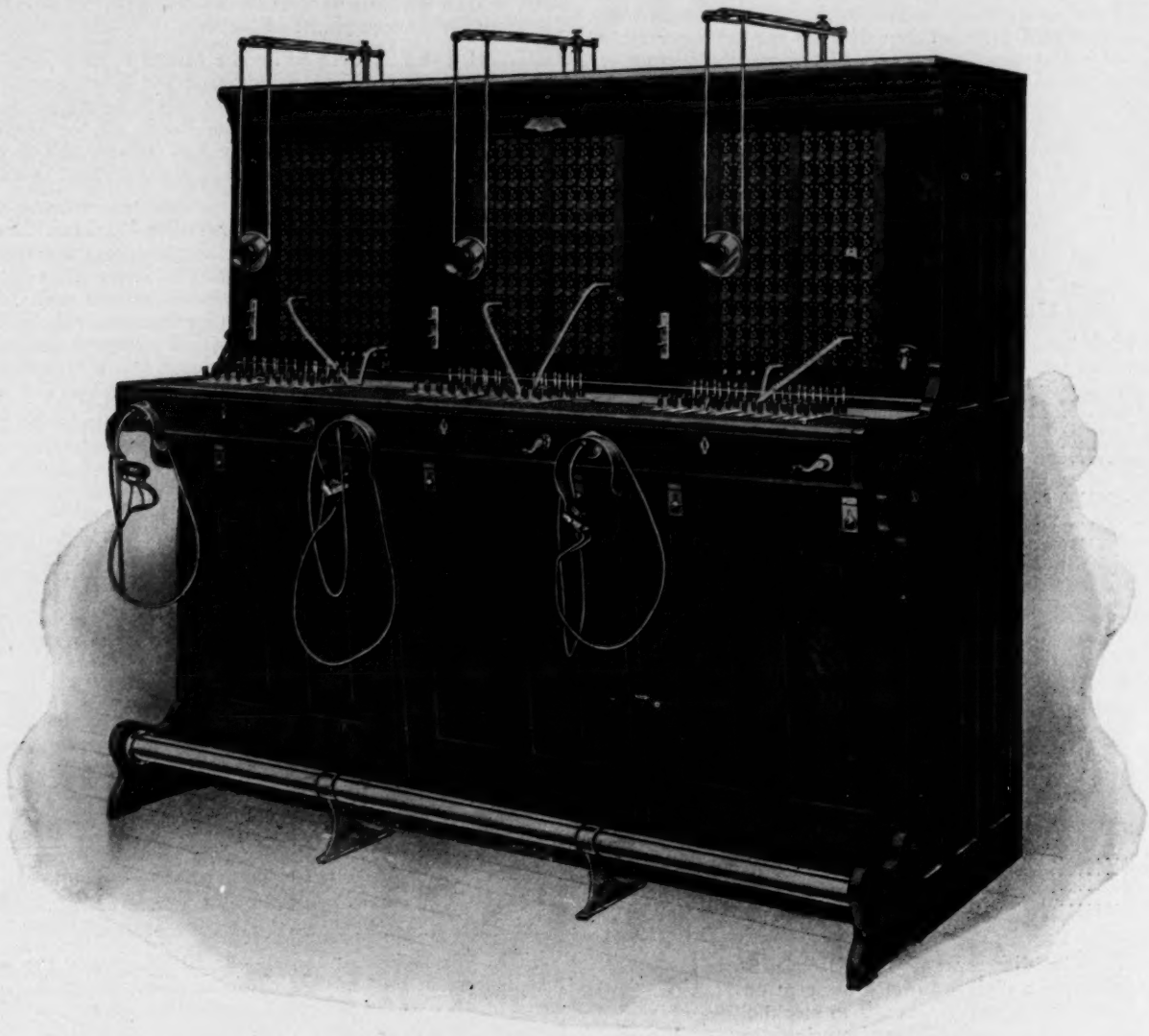
After the conversation has ended, the subscriber rings off, operating clearing out drops in the position, and then the operator pulls out both plugs. This operation illuminates the lamps in both positions, thus telling the first operator that the conversation has ended and connection should be taken down, which being done, both lamps are extinguished.

Each position is separated by a quartered oak panel. A key is mounted on the two middle and left-hand end panels, which are so arranged that only one generator, either hand or power, can be connected in at any one time. The fourth switch, as shown on the extreme right, controls the night bell alarm, the object of which is to ring a bell whenever a drop falls, thus calling the attention of the operator.

The drops are of the tubular type, which gives the maximum electrical and mechanical efficiency. The jack and drop are rigidly connected together by a metallic mounting strip, which makes their adjustment permanent. Any single drop and jack, or any part of one, can be readily removed from the board for repairs without the use of the soldering iron. The drop is cut out during conversation, presenting an absolutely free talking circuit. The jacks and drops are mounted five per strip, and fastened to a structural steel frame, with machine screw *s*. The front and back is of polished hard rubber reinforced by heavy brass, thus giving a neat appearance, combined with good insulation, and entire freedom from warping. The clearing-out drops are of the tubular type, high wound, and bridged across the cord circuit. All the drops and jacks are mounted in a structural steel framework. The combined ringing and listening keys are very simple and well constructed. The springs are of German silver, with 99 per cent pure platinum contacts.

Each key is so arranged that the operator can ring out on either answering or connecting cord. The plugs and cords are the same as used on large multiple boards, and are warranted to give satisfaction. The plugs are reinforced by a steel pointed tip. The board is wired on the full metallic plan, and is consequently readily adapted to common return or grounded circuits. The operator's transmitter is the well-known Kellogg type, adapted for long-distance work, suspended from a graceful nickel-plated arm, which has two adjustments, one for height and one for distance from the board. The head telephone is provided with a 6-ft. green silk cord, terminating in a plug, which may be inserted in the cut-in jack in the face of the keyboard, as shown in the cut. This cut-in jack is so arranged that when the operator's plug is withdrawn, the circuit of the operator's battery is automatically opened, as is also the operator's talking circuit. This prevents the wasting of the operator's battery, when the board is not in use. The operator's hand generator is of the four-magnet type, and mounted in the rear of the board where it is readily accessible.

The cabling throughout the switchboard is done with silk and cotton insulated wire. All joints are soldered to their respective terminals without the use of any acid. All the line drops and jacks may be cabled down to a connecting rack, at the bottom of the board and within the closing rear panels, or may be brought out direct in any length of cable, as desired.



TELEPHONE SWITCHBOARD.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 6 per cent for 60 days' loans. The decreased apprehensions of financial stringency caused a firmer feeling in stocks. The cut in copper prices and the reduction of Amalgamated Copper dividend brought some relief to the stock market. Anthracite coal shares, trunk lines and southern securities showed strength. Apart from Amalgamated Copper the industrial list was exceedingly dull, with a few exceptions. The traction list continued the upward movement in pirces, all of the leading stocks closing with substantial gains. Brooklyn Rapid Transit closed at 64¾, a net gain of 2⅛ points; Metropolitan Street Railway closed at 163⅜, a net gain of 3⅞, and Manhattan at 134, a net gain of 1½. General Electric, which has been steadily advancing for the past several weeks, broke the record last week and closed with a net loss of 1 point, the closing price being 281. Westinghouse Elcertic suffered a net loss of 9⅞ points, closing at 158, ex-div. Western Union closed at 91⅝, ex-div., a net gain of 1⅞ points. American District Telegraph is quoted at 36, a net loss of 1 point from the last previous quotation, and American Telephone & Telegraph closed at 162. American Telegraph & Cable closed with a net loss of 3¾ points, at 95. In Boston General Electric showed an advance of 10 points for the week, with American Telephone & Telegraph 2½ points higher. Following are the closing quotations of Monday, Dec. 23:

NEW YORK.

	Dec. 17.	Dec. 23.		Dec. 17.	Dec. 23.
American Tel. & Cable..	97	—	General Electric.....	281	281
American Dist. Tel.....	36	36¼	General Carriage.....	1½	1¼
Brooklyn Rapid Transit..	62½	64⅞	Hudson River Tel.....	104	104
Ches. & Pot. Telephone..	66	66	Metropolitan Street Ry..	161	162¼
Commercial Cable.....	181	170	N. E. Elec. Veh. Tran...	—	—
Electric Boat.....	19	19	N. Y. Elec. Veh. Tran...	12¾	12
Electric Boat pfd.....	40	40	N. Y. & N. J. Tel.....	167	167
Electric Lead Reduc'n...	1⅞	1¾	Tel. & Tel. Co. of Am....	—	—
Electric Vehicle.....	2½	2¼	Western Union Tel.....	91¼	91
Electric Vehicle pfd.....	4	4	West. E. & M. Co.....	147½	162½

BOSTON.

	Dec. 17.	Dec. 23.		Dec. 17.	Dec. 23.
Am. Tel. & Tel.....	161	161½	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	134	—
Edison Elec. Illum.....	235	250	Westinghouse Elec.....	—	80
Erie Telephone.....	19	17	Westinghouse Elec. pfd..	—	—
General Electric pfd....	—	—			

PHILADELPHIA.

	Dec. 17.	Dec. 23.		Dec. 17.	Dec. 23.
American Railways.....	43	43½	Phila. Traction.....	97¾	97⅞
Electric Storage Battery.	60	61	Philadelphia Electric....	4⅜	4⅝
Elec. Storage Batt'y pfd.	60	61	Pa. Electric Vehicle.....	½	¾
Elec. Co. of America....	6	6	Pa. Elec. Veh. pfd.....	2	2

CHICAGO.

	Dec. 17.	Dec. 23.		Dec. 17.	Dec. 23.
Central Union Telephone	40	—	National Carbon pfd....	85½	83½
Chicago Edison.....	—	160	Northwest Elev. com....	*35	37
Chicago City Ry.....	187	185	Union Traction.....	10½	10½
Chicago Telep. Co.....	240	223	Union Traction pfd.....	47	47
National Carbon.....	19¾	19¾			

*Asked.

DIVIDENDS.—The directors of the Electric Storage Battery Company have declared a dividend of 1¼ per cent on both the common and preferred stocks, payable Jan. 2 to stockholders of record Dec. 24. Westinghouse Electric & Manufacturing directors have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable Jan. 2, to stockholders of record Dec. 21, 1901. The directors of the American Telephone & Telegraph Company have declared the regular quarterly dividend of 1½ per cent and an extra dividend of ¾ per cent. The Washburn Wire Company has declared a regular quarterly dividend of 1¾ per cent on the preferred stock, payable Jan. 1. New York Metropolitan Street Railway directors have declared the regular quarterly dividend of 1¾ per cent, payable Jan. 15.

WESTERN UNION ADVANCE.—The advance in Western Union has been on the Washington report of a plan for the purchase of the Western Union and the Postal Telegraph companies by the issue of a 2 per cent Government bond. Such a plan has been under consideration for some months, it is said. The underlying principle is that a 2 per cent Government bond could be sold at par. The properties purchased would pay 5 per cent or more in dividends. The difference between the yield by the companies and the interest on the Government bond, acting as a sinking fund, would, in a comparatively short time, provide for the payment of the principle of the bonds, leaving the Government the owner of the property without any continuing cost. In view of the drop in cable securities in England, it is rather surprising that the Western Union, owning cable properties, has not declined.

A WESTINGHOUSE TRACTION COMPANY.—It is announced that the Westinghouse interests in London have formed a new company with a capital of $5,500,000, to be known as the Traction & Power Securities Company, Limited. A prime object of the new company is to receive payment in debenture securities and pay cash to the producing interest. Urgency for the formation of the company arose through a contract of the British Westinghouse Company, which is also a large shareholder, with the Mersey Railway Company for the equipment of the line.

MIAMI & ERIE CANAL.—The Miami & Erie Canal Transportation Company has filed a mortgage for $2,000,000. The Cincinnati Trust Company is trustee. The bonds bear 5 per cent and are payable in 20 years. The mortgage covers all the property owned by the company between this city and Dayton. The company is equipping the canal banks with tracks and will haul boats by electric power.

NEW YORK TRANSPORTATION.—Stockholders of New York Electric Vehicle Transportation Company have received notice that a special meeting of the stockholders will be held in Jersey City on Jan. 9, 1902, to vote on decreasing the capital stock from $25,000,000 to $5,000,000 and changing the name of the company to New York Transportation Company, as recommended by the board of directors.

NEW BRUNSWICK & TRENTON RAILWAY.—A mortgage for $1,000,000 has been filed with the County Clerk by the New Brunswick & Trenton Railway Company, recently incorporated to construct a third-rail electric railway from Milltown to Trenton. The mortgage is given to secure an issue of $1,000,000 is bonds, and is given to the Finance Company of Pennsylvania.

UTICA & MOHAWK VALLEY.—N. W. Harris & Co., of New York City, offer to investors $1,400,000 Utica & Mohawk Valley Railway Company 40-year 4½ per cent gold bonds. These bonds are secured by a mortgage on the entire street railway system operating under perpetual franchise in Utica and adjacent cities, including branches now in process of construction.

AMERICAN LIGHT & TRACTION.—The Emerson-McMillin interests of New York have secured control of the Lincoln Gas & Electric Light Company. The concern will be reorganized at once with a capital of $1,500,000.

ANSONIA BRASS & COPPER COMPANY has increased its capital from $1,500,000 to $2,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Retail trade was the most prominent feature in the business situation, being stimulated by the influences of very cold weather throughout the country, and a more pronounced holiday demand, while jobbers in many lines report a good re-order business growing out of the above conditions. Wholesale trade, as a rule, has been seasonably quiet, among the exceptions to this being iron and steel. According to *Bradstreet's*, the holiday influences have not been entirely favorable to active business, as is proved by the general quieting down of demand and the easing of values in the leading speculative markets. The feeling in these markets, however, is one of deferred rather than postponed activity, the turn of the year being expected to bring marked developments in all lines. The spectacular feature of the week in prices has been the continued marking down of copper and the sympathetic drop in tin and lead. Bank clearings and railroad earnings continue to maintain their high average, and there is no visible backward tendency in the general volume of business now as compared with a year ago. Slow but steady accretions in the price of pig iron are proof of the heavy buying going on in the cruder forms, which vies with the active call for bars, sheets, plates, rails and structural material among unfinished products. The returns of railroad earnings show that 50 roads earned 8 per cent more in the first week of December this year than the same month last year, while for the second week 42 roads show a gain of $400,000 over the middle week of De-

cember last year. In sharp contrast to the strength in iron and steel is the weakness of copper, a result of the failure of combinations to artificially maintain prices. The metal is four cents lower than it was two weeks ago, and yet the actual demands seem slow to materialize. During the week two declines of 1⅜ cents were made. The United Metals Selling Company announced a decline of 1⅜c., quoting Lake at 15⅜c. to 15⅝c.; electrolytic, 15c. to 15¼c., and casting, 15c. A later official cut brought the price down to 14c. for Lake, 13⅞c. for electrolytic, and 13c. for casting. The business failures for the week, as reported by *Bradstreet's*, numbered 262, as against 233 the week previous, and 262 the same week last year.

EDISON PORTLAND CEMENT COMPANY, at Stewartsville, N. J., on the Pennsylvania border, about two miles from Easton, has been making great headway with its work, and Superintendent Darling expects to be running full blast early in the spring. Last week Mr. Edison, accompanied by some of the directors and large stockholders and by Messrs. Mallory and Upton, visited the property, and all were much gratified at the progress found. Mr. Edison, it may be mentioned, is working on an extensive ledge of natural cement rock, which gives practically an exact Portland assay, and the deposit is so great that the plant now equipped for 10,000 barrels a day can be run on it for at least a century. The deposit begins about a mile from the vast works, and part of it has already been stripped, two large steam shovels being already at work on the face about 80 ft. down. The Allis engines for the works are in position, supplemented by an Armington & Sims, and most of the machinery is ready to run. A good deal of it is due as usual to Mr. Edison's invention and initiative—all looking to economy of labor and effort. About 100 electric motors, from 100 down to 5 hp, will drive the mechanism, in addition to direct engine drives, and the motors are chiefly General Electric, with some Crocker-Wheeler. Mr. Edison finds the motors admirably adapted for such work, and has himself devised several ingenious automatic features for their control and cut off. The prospects for a profitable industry are extremely good, and present inquiries alone would keep the plant running all the time, while when it starts it will be one more proof of Mr. Edison's versatility, courage and perserverance.

THE HAINES & NOYES COMPANY, which makes a specialty of telephone apparatus for private telephone plants, has recently closed up four large contracts with Stone & Webster, 93 Federal Street, Boston, Mass., for equipping the following electric railways: Ponce Electric Railway & Light Company, Ponce, Porto, Rico; Tampa Electric Railway Company, Tampa, Fla.; Houghton County Street Railway Company, Houghton, Mich.; Blue Hill Street Railway Company, Milton, Mass. The telephone apparatus for the Ponce Railway & Light Company and the Tampa Electric Railway Company consisted of a number of water-proof iron box telephones, which contained a bridging generator, a hand microphone with extra long cord, two "Hydra" double batteries and long lever hook with German silver springs and platinum contacts. These iron box telephones have the name of the electric railway company printed on them, and they are very small and compact. A number of desk telephones were also furnished with this equipment. The equipment for the Houghton County Street Railway Company consisted of a number of portable car telephones containing a bridging generator, two "Hydra" double batteries and a hand microphone mounted in a small but heavy oak box with dove-tail corners. When the lid is opened the battery is cut in. These little telephones have nickel plated hinges and nickeled handle for carrying, and they may be connected anywhere on the telephone line. The Blue Hill Street Railway Company's equipment consisted of Haines & Noyes standard wall sets.

TELEPHONY IN EGYPT.—The Telephone Company of Egypt, Limited, operating a large telephone system in Egypt, has experienced great difficulty in securing a suitable pole. The climate of the country is so hot and dry that good timber to use for a pole line for the transmission of an electric current, does not grow and timber imported from other countries dry-rots and becomes useless in a very short time. A certain pole imported from Sweden proved to be the most valuable so far, but its greatest life was not over four years. The company began negotiations, therefore, with cedar pole firms in the United States, with the result that arrangements have just been completed with W. C. Sterling & Son, of Monroe, Michigan, wholesale producers of cedar poles, ties and posts for the shipment of 1500 poles of the white cedar variety, Michigan grown, to Alexandria and Cairo, Egypt. Correspondence opened between the two firms last June, but owing to the great distance and slow transportation of mail matter, arrangements were not completed until last week, and the shipment of the material will begin at once. Sterling & Son have earned an enviable reputation as reliable dealers and have, it is understood, made the only previous shipment of material in their line to a foreign country. Two years ago they made a large shipment to Beunos Ayres, South America, and naturally feel elated at receiving a second foreign order. They are now negotiating for the shipment of a large order for poles to Spain and Portugal.

ENLARGING BULLOCK FACTORY.—The Bullock Electric Manufacturing Company will soon erect one of the largest machine shops in the country. Plans have been prepared and contracts will be let in the near future for an addition to the plant which will double its present capacity. The new machine shop will be built with a view to building electrical units of the largest size. The machine shop will be 62 ft. under the roof trusses, the main span will be 75 ft. between the crane tracks with two more spans of 45 ft. each between the crane tracks. The building, when entirely finished, will be 1200 ft. long, and will cost $150,000. The decision to push the building to completion at this time is in part due to a contract closed recently with the Cincinnati Gas & Electric Company for electrical equipment, to the amount of $250,000, to be delivered in nine months. The contracts call for two 3200-kw generators to be direct connected to two Allis engines with a nominal rating of 3750 hp, and a maximum capacity of 5500 hp. One of the generators will be of the direct-current type, 75 r. p. m., 300 volts, and will supply current to the three-wire system of the company, while the other unit will be of the alternating-current, revolving field type. The total weight of this generator will be 660,000 lbs. The Cincinnati Gas & Electric Company will erect a new building that will be a duplicate of the one now in operation.

H. W. JOHNS-MANVILLE COMPANY.—The H. W. Johns Manufacturing Company, of New York, and the Manville Covering Company, of Milwaukee, each company having been closely identified as handling the goods manufactured by the other, have consolidated their interests. This consolidation is to take effect Jan. 1. The new company, whose capital stock will be $3,000,000, will be known as the H. W. Johns-Manville Company. The officers of the new company will be: Mr. T. F. Manville, president; Mr. C. B. Manville, vice-president; Mr. George W. Gladwin, vice-president; Mr. F. R. Boocock, treasurer, and Mr. H. E. Manville, secretary. Mr. James G. Cannon will be chairman of the board of directors. Mr. C. R. Manville will be manager of the Western department, and he, with Mr. C. B. Manville, will remain in Milwaukee. Mr. T. F. Manville and Mr. H. E. Manville will remove to New York. The new company is rapidly completing a plant at Milwaukee for the manufacture of carbonate of magnesia and mineral wool. When this plant is completed, the company will be prepared to furnish a most complete line of all grades of steam pipe and boiler coverings and asbestos goods of all descriptions.

ELECTRIC VEHICLE COMPANY.—Great interest has been aroused in electrical and automobile circles in this city by the action of the Electric Vehicle Company in closing down its Elizabethport factory and concentrating practically all its manufacturing work at Hartford. Colonel G. H. Day, when seen in this city last Thursday, accompanied by Superintendent Budlong, stated that all the necessary plans had been carried out, and that great benefits were expected from the change, especially in the economies due to producing automobiles all from one plant. It is now stated that in connection with these changes, Messrs. A. L. Riker, H. M. Byllesby and A. H. Whiting have resigned from the Electric Vehicle Company. The prominence of these gentlemen in the company and in electrical work naturally invests this news with considerable importance, and their moves and plans are awaited with much interest. Mr. Byllesby is a late comer into the automobile field, from other electrical branches, but Messrs. Riker and Whiting have long been prominent in it, and the former has made a deep mark on the art.

PROMINENT BUYER HERE FROM SPAIN.—J. F. Villalta, the principal of the house of J. F. Villalta, Barcelona, Spain, which is the only concern handling American machinery exclusively in that part of the world, has arrived in the United States with a view to placing some substantial contracts, including electrical machinery, supplies, machine tools, etc. He may be found downtown at the offices of the foreign freight contracting and forwarding firm of Alfred H. Post & Co., Produce Exchange. Mr. Villalta, who, according to present arrangements, expects to be in America for about a week or ten days, is at the Hotel America, Irving Place and Fifteenth Street.

AMERICAN BICYCLE COMPANY interests have incorporated two companies in New Jersey, one the American Bicycle Manufacturing Company, with $8,000,000 capital, the other the International Motor Car Company, with $2,000,000 capital. The new bicycle company will take over the bicycle department of the big company, and the new motor company will make and operate automobiles. The capital stocks of the new companies will be held by the American Bicycle Company.

GAS DRIVEN GENERATORS.—The Lackawanna Iron & Steel Company, of Buffalo, N. Y., are putting in a new power plant, which comprises three 500-kw Sprague split pole generators, to furnish current for motors, lights, etc. The Sprague Electric Company has received a handsome contract. The generators will be driven by three German gas engines.

AMERICAN EQUIPMENT FOR FIRST TOKIO ELECTRIC TRACTION SYSTEM.—The Tokio Densha Tetsudo Kabushika Kwaisha, which Japanese concern will operate the first street railway in Tokio, placed last week indirectly a contract with the General Electric Company for the generators, engines, boilers, pumps, condensers, heaters, etc., for its projected power house equipment, also for the trucks and motor equipment for the cars. The value of the contract is stated to be about $750,000. As the Tokio company, in view of the monetary stringency at present existing in Japan, was desirous of securing an extended credit for its purchases in this country, financial arrangements have been made through the Japanese house of Mitsui & Co., 445-7 Broome Street, whereby that firm guarantees the payments for the machinery, etc., ordered from the General Electric Company. The power house plant will include three 1200-kw direct-connected G. E. generators and six rotaries of 400 kw each; three cross-compound horizontal engines of 1800 hp capacity each, to be manufactured by McIntosh, Seymour & Co., and eight 350-hp boilers to be built by the Babcock & Wilcox Company. The pumps comprising three main condensing outfits, one for the exciter engine, two feed pumps and three small equipments to be utilized for drainage and oil purposes are to be manufactured by the Blake branch of the International Pump Company, 120 Liberty Street. There will be four heaters of Wainwright make. The Morgan Engineering Company, Alliance, Ohio, will build a 20-ton overhead electric crane. The contract for piping, valves, etc.—valued at about $25,000—is not included in the General Electric contract, it having been awarded to McMann & Taylor, of 104-6 John Street. The trucks will be manufactured by the Peckham Manufacturing Company, of Kingston, N. Y., 250 having been ordered. They will be fitted with double-motor equipments of G. E. 54 type. The car bodies, owing to the cheapness of wood in Japan, will be manufactured there. The rails will be purchased in England. The company will commence operations by utilizing 22 miles of track through the principal streets in Tokio. It is anticipated that everything will be ready for business early in 1903. Mr. Enyo, chief engineer of the Tokio enterprise, has sailed for home this week via Vancouver. Orders for machine tools, etc., have yet to be awarded.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Dec. 18: Antwerp—9 pkgs. material, $720; 9 pkgs. machinery, $2,609. Alexandria—3 pkgs. material, $60. Argentine Republic—48 pkgs. material, $770; 13 pkgs. machinery, $1,623. Brussels—4 pkgs. material, $882. Brazil—25 pkgs. material, $1,380; 611 pkgs. material, $8,466. British East Indies—9 pkgs. machinery, $2,350. Bordeaux —1 pkg. machinery, $711. Barcelona—17 pkgs. copper wire, $3,100. British West Indies—28 pkgs. material, $991; 1 pkg. machinery, $21; 1 pkg. motors, $47. British Australia—247 packages material, $17,000; 299 pkgs. machinery, $47,238. Central America—14 pkgs. material, $283; 1 pkg. material, $420. China—2 pkgs. material, $50. Cuba—49 pkgs. machinery, $3,152; 331 pkgs. material, $3,467; 76 pkgs. wire, $1,152. Dublin—1 pkg. wire, $91. Hong Kong—35 pkgs. material, $2,550. Havre—31 pkgs. material, $771; 5 pkgs. machinery, $245. Japan—38 pkgs. material, $8,535. Leicester—6 pkgs. machinery, $200. Liverpool—13 pkgs. machinery, $814; 68 pkgs. material, $3,284. London—188 pkgs. machinery, $8,219; 160 pkgs. material, $5,774; 100 pkgs. wire, $1,200; 2 pkgs. wire, $140. Marseilles —20 pkgs. material, $100. Manchester—10 pkgs. machinery, $1,600. Moscow—12 pkgs. material, $1,085. Mexico—70 pkgs. material, $4,232; 27 pkgs. wire, $125; 14 pkgs. wire, $636; 150 pkgs. wire, $2,277. Nova Scotia—9 pkgs. material, $160. Newfoundland—13 pkgs. material, $132. Newcastle—15 pkgs. machinery, $1,722. Peru —16 pkgs. material, $429; 82 pkgs. copper wire, $1,968. Philippines —101 pkgs. material, $3,248; 89 pkgs. machinery, $12,653. Rotterdam—3 pkgs. goods, $130. Santo Domingo—3 pkgs. material, $25. Southampton—8 pkgs. material, $127. Siam—34 pkgs. material, $1,700. Stockholm—7 pkgs. machinery, $900. Taunton—7 pkgs. machinery, $3,000. Uruguay—8 pkgs. material, $351; 2 pkgs. machinery, $1,000. Venezuela—1 pkg. machinery, $20; 80 pkgs. material, $345; 2 pkgs. wire, $20. Yarmouth—12 pkgs. wire, $891.

COMBINATION IN MISSOURI.—C. E. Hart, of Joplin, who is said to represent the Westinghouse Electric & Manufacturing Company, submitted a proposition to the City Council Dec. 3 to purchase the municipal electric lighting plant. Mr. Hart made a similar proposition to the Council of Carthage, Mo. He offers to pay the cost of a special election if the Council will signify its consent. The deal has been progressing quietly for the past two weeks, and it was learned that the transaction may assume large proportions by consolidating the lighting companies of Southwest Missouri and Southeast Kansas. Such a combination would include the Southwest Missouri Electric Railway Company, which runs from Carthage, Mo., to Galena, Kan., the municipal and corporate plant at Carthage, the municipal plant at Joplin, the corporate plant at Galena, Kan., and possibly the Southwest Missouri Electric Light Company, which supplies Joplin, Webb City and Carterville, Mo., with private electric light and power.

WATER POWER DEVELOPMENT IN MONTANA.—Former Governor S. T. Hauser, of Montana, has perfected plans for a second dam above the present Canyon Ferry plant on the Missouri River, to furnish power and light to the mines and smelters in Butte, Mont. All the necessary land joining the dam site has been secured by the company, and in the spring work will be started and the dam proper built, when the water of the Missouri is at low ebb. The construction of a second dam on the river will entail an outlay of something like $1,000,000. From Stubbs Ferry to Canyon Ferry, a distance of 6 miles, a new pole line will be built. From Canyon Ferry to Butte and to Helena the power will be transmitted over a new aluminum line. The plant will have a capacity of 20,000 hp, and will be one of the largest power plants in the Northwest. A large amount of power will be used in Butte. In this connection it might be said that there is every probability of several large power plants being constructed next year in different parts of Montana.

EQUIPMENT ORDERS PENDING FOR MATTEAWAN (N. Y.) PLANT.—W. M. Sheehan & Co., electrical engineers and contractors of 136 Liberty Street, New York City, which concern is building and equipping the new plant of the Citizens' Street Railway Company, Matteawan, N. Y., will shortly give out contracts for a 400-hp Corliss engine and a 225-kw belted generator, shafting, and so forth. The induced draft system will be employed in the plant. The boiler order calling for two boilers of 200 hp each has already been contracted for with Thayer & Co., Incorporated, of 39-41 Cortlandt Street. These boilers will be built by the Aultman & Taylor Company, of Mansfield, Ohio. The new plant is expected to be in operation by May next.

EDISON CENTRAL STATION BOILERS.—All the boilers in the Edison Electric Illuminating Company's plant at Paterson, N. J., have been equipped with the "Potter" mesh separator (dry pipe) and superheater. The owners state the steam at the boiler outlet has been improved 50 per cent, as shown by calorimeter tests for dryness, and that the parties have no trouble with water in their steam engines. Messrs. James Beggs & Co., 9 Dey Street, New York, are meeting with much success with the "Potter mesh," which was described before the American Society of Mechanical Engineers a couple of weeks ago by Mr. Fred Scheffler, the well-known steam and electrical expert, and was duly noted at that time in these pages.

EQUIPMENT FOR LORILLARD'S PLANT.—The P. Lorillard Company's tobacco plant at Jersey Street, which is about to be operated by electricity, will be equipped with 45 two-phase alternating-current motors, varying from 2 to 30 hp, built by the Westinghouse Electric & Manufacturing Company. The wiring for these motors as well as for 1300 incandescent lamps will be executed by W. M. Sheehan & Co., of 136 Liberty Street, with John A. Roebling's Sons Company's wire.

CINCINNATI CONTRACTS.—The Bullock Electric Manufacturing Company, of Cincinnati, has, as stated above, the contract for two 3200-kw generators to be installed in the new plant of the Cincinnati Gas & Electric Company, contracts for the erection of which will be let at once. The Allis-Chalmers Company has secured the contracts for two 3750-hp engines. Contracts call for the delivery of the machinery within nine months.

THE ACME SWITCH COMPANY, of Hartford, Conn., whose address has recently been changed to 438 Asylum Street, is moving from its old shop to one much larger, and is installing machinery to enable it to do all of its own work. It hopes in this way to catch up with accumulated orders. On Dec. 3 the company increased its capital stock from $12,500 to $25,000.

THE HALL SIGNAL COMPANY has recently fully paid off out of its earnings a $200,000 issue of bonds, dated 1894, due 1904. This represents the entire bonded debt of the company. The company now has on hand a handsome surplus, and besides doing a large business in this country the company is putting its signal system on railroads in Belgium, France and England.

NEW STILWELL-BIERCE & SMITH-VAILE SHOPS.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, whose New York offices are in the Washington Life Building, 141 Broadway, has just appropriated $150,000 for the purpose of erecting new foundry and machine shops.

General News.

THE TELEPHONE.

GADSDEN, ALA.—Alabama & Georgia Long Distance Telephone Company has increased its capital stock from $10,000 to $30,000.

SCOTTSBORO, ALA.—The citizens of Paint Rock Valley are building a co-operative telephone line up the valley from Paint Rock station.

COURTLAND, ALA.—The long distance telephone system is now being put up here. The local telephone exchange will also be put in as soon as the poles can be placed.

SAN FRANCISCO, CALIF.—It is reported that the Alaska Telephone Company has let contracts for the early construction of a telephone line from Nome to Council City, Alaska, a distance of 100 miles. It is the intention of ex-Mayor Harry White, of Seattle, Wash., who is the promoter of the enterprise, to build an extension of 200 miles from Nome to Teller and Kougurock. Telegraph lines, also, are included in the company's plans.

JACKSONVILLE, FLA.—The Peninsular Telephone Company has a charter for a system in this city, and has arranged to commence work at once.

DUBLIN, GA.—J. O. Persons, of Greenville, S. C., will organize a stock company for the construction of an independent telephone system at Dublin.

EDELSTEIN, ILL.—Van Antwerp and Baily are building a telephone line south from Edelstein.

MATTOON, ILL.—The Farmers' Mutual Telephone Company, capital stock $10,000, has been incorporated by J. F. Miller, J. F. Brewster and A. G. Hildreth.

WEST FREEPORT, ILL.—The West Freeport Village Board granted a twenty-year franchise to Bills & Wortham for the construction of a telephone system.

PITTSFIELD, ILL.—The stockholders of the Pike County Telephone Company will consider a proposition to increase the capital stock from $20,000 to not to exceed $40,000.

ROCKFORD, ILL.—A charter was filed for the Rockford Home Telephone Company, with a capital stock of $200,000. Incorporators: George F. Miner, George F. Wilson and F. M. Puffer.

ALTON, ILL.—It is rumored that the Kinloch long distance telephone people of St. Louis are contemplating the erection of an electric lighting plant in Alton, and that they will go into competition with the present Alton Railway, Gas & Electric Company. The officers of the Kinloch Company refuse to talk of the project, but several of the members of the Council state that they have been talked to about the matter officially.

SOUTH WHITLEY, IND.—The South Whitley Telephone Company filed application for a franchise in Huntington, Ind.

SHELBYVILLE, IND.—John A. Tindell, of this city, is negotiating for the purchase of the plant of the Mutual Telephone Company.

EVANSVILLE, IND.—The Eureka Telephone Company requests the right to operate in this city. Charles Laval is its representative.

JEFFERSONVILLE, IND.—The Independent Long Distance Telephone & Telegraph Company has been granted a franchise by the Scott County Commissioners.

PORTLAND, IND.—The Redkey Telephone Company has asked a franchise of the County Commissioners of Jay County. An extension of its lines is under contemplation.

INDIANAPOLIS, IND.—The Independent Long-Distance Telephone & Telegraph Company, of Delaware, capital $200,000, has complied with the foreign incorporation law. Its Indiana investments are placed at $25,000, and C. D. Knoefel, of New Albany, is named as State agent.

INDIANAPOLIS, IND.—The Mooreland Rural Telephone Company, of Mooreland, with a capital of $1,500, and the Halleck Telephone Company, of Rensselaer, capital $10,000, have been incorporated. The former's board of directors is headed by W. E. Moore, and the latter's by Charles Halleck. The Mooreland Company will operate a village exchange with farmer-line connections, and the Halleck Company will operate an extensive system in Jasper and fifteen contiguous counties. The plan is to buy up and consolidate the smaller plants into one system.

BRAZIL, IND.—The New Long Distance Telephone Company, which has been planning to parallel the Central Union from Terre Haute to Indianapolis, has reached this city with the poles, and the company asserts that the wires will be strung and the exchanges will be in operation between this city and Terre Haute within ten days. This company will co-operate with the newly organized Brazil Telephone Company, which was recently granted a local franchise by the City Council. Until now the Central Union has enjoyed an undisputed monopoly of the telephone business here. The new company proposes to erect a rural exchange, to touch all the important towns in the county.

ROCHESTER, IND.—The growth of the independent telephone industry is fairly sweeping this section of the State. Logansport, Peru and South Bend are being equipped with the finest of new independent plants, and a franchise has just been granted to a Fort Wayne syndicate to put in an independent system at Hammond. When these plants are completed they will afford independent telephone service to every town in the northern part of the State. Even little towns of a few hundred inhabitants are putting in exchanges, and the farmers in surrounding territory are being connected with town and toll line service on party lines. At Silver Lake and Bann automatic switchboards are being put in. Between the larger exchanges full metallic copper toll lines are being constructed.

MARCUS, IA.—A franchise has been granted to two citizens to construct and operate a telephone system in this town.

ATLANTIC, IA.—The residents of the country between Massena and Cumberland are preparing to build a telephone line.

CALIFORNIA, IA.—A rural telephone line is being installed in the farmers' homes between Missouri Valley and California Junction.

MORNING SUN, IA.—The Morning Sun Telephone Company has filed articles of incorporation with a capital stock of $10,000. Fred. Courts is president.

ANAMOSA, IA.—Jones County Telephone Company, capital stock $50,000, has been incorporated. President, L. H. Camp; vice-president, L. Middleton; secretary, C. H. Brown; treasurer, H. F. Camp.

COIN, IA.—The Coin & Northboro Telephone Company, capital stock $7,000, has been incorporated by W. T. Uttvitts, John H. Roll, F. E. Bryant, Lewis Harris, John Haisch, J. R. Harris, J. K. Herron, J. F. Whitmore and Ed. F. Rose.

GOWRIE, IA.—A telephone exchange will be installed here. The franchise was granted to Robert L. Parker. Several rural lines are being planned, and the indications are that Gowrie will soon be the center of an extensive telephone system.

FRANKFORT, KY.—The Burning Springs and East Bernstadt Telephone & Telegraph Company, of Laurel County, has been incorporated, with a capital stock of $2,000. R. M. Jackson is the chief stockholder.

VANCEBURG, KY.—Mayor-elect A. J. Stein has purchased the Odd Fellow telephone that runs between Tolesboro and Maysville, and will soon begin the erection of a line connecting Vanceburg with Tolesboro, thereby giving connection with Maysville.

BALTIMORE, MD.—The plan for the lighting and drainage of Baltimore, which has many novel features and great possibilities, is to construct a canal between Baltimore and the Susquehanna River which will convey a sufficient amount of water to flush the harbor and produce the sanitary conditions needed for over 1,000,000 population. The water would be brought in at an elevation of about 125 feet. With it the city would light the streets and operate the water department pumps, and it would have enough left to supply all the inhabitants of Baltimore at a much lower rate than the cost of steam, which will produce a revenue of from $1,000,000 to $2,000,000 annually. The canal would be about thirty-five miles long, and if it could be excavated through dirt would cost about $4,500,000.

OMENA, MICH.—The farmers at Northport and Omena have organized local independent telephone companies.

ALBION, MICH.—A new telephone franchise for the People's Telephone Company has been asked of the City Council.

DETROIT, MICH.—The Michigan Telephone Company will increase its rates on Jan. 1. It claims to have about 12,000 subscribers in Detroit. Among subscribers there seems to be much opposition to the increase.

McCOMB CITY, MISS.—The Pike County Telephone Company has been purchased by J. J. White, Dr. O. B. Quin, T. W. James and W. R. Caston. Dr. O. B. Quin was elected president, W. R. Caston vice-president and T. W. James secretary and treasurer. The lines will be extended and the service will be generally improved. The company now has exchanges in Summit, McComb City, Magnolia and Osyka.

HELENA, MONT.—The Yellowstone Park Telephone & Telegraph Company has increased its capital and changed its place of business from Bozeman to Livingston.

BAY, MO.—The Gasconade Central Telephone Company, capital stock $1,200, has been incorporated by E. T. Williams, W. F. Langenberg, Peter Danuser and others.

KANSAS CITY, MO.—The Missouri & Kansas Telephone Company will expend $1,000,000 between Jan. 1 and May 1 next year, in improving its system in this city and Kansas.

SEDALIA, MO.—The Telephone Association of Central Missouri, composed of independent lines, was organized here recently, and the following officers were elected: G. W. Schweer, of Windsor, president; Dr. Force, of Jefferson City, first vice-president; Fred. A. Churchill, Sr., St. Louis, second vice-president; J. Golloday, Holden, secretary. The following towns are members of the association: Fayette, Glasgow, Columbia, Boonville, Bunceton, California, Jefferson City, Windsor, Clinton, Calhoun, Warrensburg, Holden, Harrisonville, Caldwell County and Sedalia. This city was made the permanent headquarters of the association.

EAGLE, NEB.—The Eagle Telephone Company has been organized. A. C. Adams is president, Frank Clements vice-president and S. A. Morrison secretary.

LONG PINE, NEB.—A company has been organized by the business men of Long Pine to build a telephone line from this place to the "A. D." cattle ranch via Selden, Spragg and Butler. M. D. James, of Spragg, is president.

BETHANY, N. Y.—It is said that farmers are arranging to build a telephone line from Batavia to Bethany.

NEWBURGH, N. Y.—The Hudson River Telephone Company has installed an exchange in Walden with thirty-five subscribers.

BINGHAMTON, N. Y.—The independent telephone system in Binghamton now has 775 subscribers. It will soon be connected with a Broome County long distance line.

ALBANY, N. Y.—The Utica Home Telephone Company has been incorporated; capital, $200,000. Directors: C. H. Poole, H. F. Miller, and E. B. Odell, of Utica.

CLYDE, N. Y.—The Lyons Telephone Company and the Wayne Telephone & Telegraph Company, including all rights, privileges, and franchises, trunk lines and local exchanges, owned and controlled by H. P. and S. E. Bishop, of Clyde, have been pruchased by the Eastern Electrical Construction Company, of Philadelphia, Pa.

COLUMBIA, OHIO.—A new telephone line is to be erected in Columbia.

STONE, OHIO.—Charles Haas contemplates building a telephone line to Steubenville.

BELLEVUE, OHIO.—The Bellevue Telephone Company has completed a line from Bellevue to Colby Station, giving connection from Bellevue to Clyde.

SHELBY, OHIO.—The business of the People's Telephone Company has been growing rapidly of late, and service is now given to nearly 500 subscribers.

NORTH LIMA, OHIO.—The farmers and business men of Beaver Township will hold a meeting to form a stock company, to put up an independent telephone line.

ZANESVILLE, OHIO.—The Zanesville Telephone & Telegraph Company has practically completed its system and about two-thirds of its 1000 subscribers have been connected up. This is one of the new properties controlled by the Federal Telephone Company of Cleveland.

CHICAGO JUNCTION, OHIO.—The growth of the Huron County Telephone Company's exchange here has been remarkable. At present there are 320 telephones in operation and it is expected that before the new management's first year is up there will be 400 telephones connected.

CLEVELAND, OHIO.—There is considerable speculation among Cleveland financiers as to the cause of the drop in the price of Federal Telephone securities. A month ago the stock was quoted at in the neighborhood of 28, but since then it has been steadily falling, with a sudden drop of several points a couple of weeks ago. On Dec. 14 the stock was offered at 15, with no takers, but since then there has been a slight improvement. At the same time the new business being secured by the Federal properties is of the most promising character. Exchanges at Cleveland, Columbus, Dayton, Mansfield, Bowling Green, Massillon, Findlay, Zanesville, Lima, Canton, Shelby, Dunkirk, Youngstown, Alliance, Fostoria, Portsmouth, Lancaster and Galion show a gain in new business for November of $40,946. Total number of telephones added to these properties was 1837. Average cost of securing the business was $1.76. As compared with the month of October, the gain in contracts was nearly 500. The gain in total revenue over $11,000 and the gain in average revenue per contract was about $4. A number of the plants have reached the limit of switchboard capacity and will require new equipment. The United States Telephone Company (long distance) shows a net gain in revenue during November of over $2,500 and carried over $3,600 to dividends.

GUTHRIE, OKLA.—The Texas Telephone Company has filed notice of its intention to do business in Oklahoma and of the appointment of W. J. Donald, of Lawton as its territorial agent. The company has a capital stock of $3,000.

WOODWARD, OKLA.—The Home Enterprise Telephone Company, of Woodward, has been incorporated, with $10,000 capital stock. Directors: C. R. Alexander, E. S. Wiggins, Geo. H. Brophy and J. H. Hopkins, E. B. Roll, B. W. Key and F. D. Healey, L. B. Collins and Chas. Swendall, all of Woodward.

OTTAWA, ONT.—At the January elections the question of the establishment of a municipal telephone system will be voted upon. The agreement between the Bell Telephone Company and the city expires early in April, 1903, and it is considered in the interests of the citizens that a telephone system, under municipal ownership and operation, should be inaugurated. The proposition will undoubtedly carry by a large majority.

SCOTLAND, S. D.—The Western Electric Telephone Company has decided to extend its line direct from Tabor to Yankton.

HURON, S. D.—A new telephone line is being constructed to connect Huron, La Delle, Lake Byron, Sheffield and other towns in that part of the State.

JACKSON, TENN.—C. L. Meyers, of Chicago, has completed arrangements for the construction of the Jackson Home Telephone Company.

CHATTANOOGA, TENN.—The City Telephone Company has been granted a charter for the purpose of constructing a new telephone plant system in this city. Capital stock, $50,000.

GRAHAM, TEX.—The Northwest Texas Telephone Company, capital stock $5,000, has been incorporated by R. J. Graham, W. L. Donnell, J. H. Ball and others.

NACOGDOCHES, TEX.—The Central Texas Telephone Company, of Nacogdoches, capital stock $10,000, has been incorporated by E. C. Branch, W. S. Beeson and W. S. Patton.

BRENHAM, TEX.—At a meeting of the stockholders of the Brenham and Brazos Valley Telephone Company, the following officers were elected: J. T. Hairston, president; W. M. Aven, vice-president; O. A. Seward, secretary.

SALT LAKE CITY, UTAH.—Citizens of Daisy and Rice, Wash., are building a telephone line between those points, connecting with each farm house.

SALT LAKE CITY, UTAH.—The Pacific Telephone Company, of Spokane, Wash., will enlarge its present quarters to twice the size. The new addition will allow the accommodation of about 10,000 new subscribers. When the company entered its building two years ago it had less than 3000 telephones in use. The increase in the past two years has been remarkable, and the company's local representatives say that there is every indication that it will continue. Four new switchboards have been ordered from New York. The work of construction will commence at once.

EVERETT, WASH.—The Sunset Telephone & Telegraph Company will erect a two-story brick building for headquarters in this city.

MADISON, WIS.—The Great Western Telephone & Telegraph Company, of Milwaukee, capital stock $500,000, has been incorporated by C. G. Foster, E. R. Stillman and C. W. Milbrath.

JANESVILLE, WIS.—There are nearly 50 cities in this State that have exchanges of over 100 telephones, and scores of smaller places with a less number. Following is a list of the exchanges of 100 subscribers or more: Madison, 1350; Appleton, 1200; Superior, 812; La Crosse, 860; Racine, 800; Janesville, 785; Sheboygan, 700; Richland Center, 650; Fond du Lac, 500; Wausau, 480; Beloit, 475; Baraboo, 400; Portage, 355; Monroe, 340; Viroqua, 320; Grand Rapids, 305; Rhinelander, 300; Elkhorn-Delavan, 300; Merrill, 295; Hancock, 210; Brodhead, 200; Mauston, 200; Evansville, 300; Reedsburg, 200; Clinton, 197; St. Croix Falls, 195; Sparta, 190; Edgerton, 180; Pardeeville, 175; Fort Atkinson, 174; Marshfield, 170; Neillsville, 165; Tomah, 140; Platteville, 136; Mineral Point, 134; Prairie du Chien, 130; Lancaster, 125; Barron, 125; East Troy, 120; New Richmond, 120; Ripon, 120; Sauk City, 102; Plymouth, 100; Milton, 100.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Douglas Electric Company has completed a new electric lighting system, which will supply lights and power in Roseburg, Ore. The generating machinery is located in the new pumping station of the Roseburg Water Company and operated by hydraulic power.

SAN FRANCISCO, CALIF.—The Washington Water & Power Company, which controls the water power of the falls of the Spokane River, has begun a survey for a pole line for its projected electric power transmission to the Cœur d'Alene silver and lead mines in Idaho. The length of this line from Spokane, Washington, to Northern Idaho is about 100 miles.

SAN FRANCISCO, CALIF.—Bakersfield, Calif., now has a city ordinance regulating the granting of franchises and providing for the placing of all electric light and telephone wires underground. Within three years all poles and wires used for transmitting electricity are required to be removed from the public streets and placed in underground conduits. No franchises will hereafter be granted to companies for overhead wiring.

SAN FRANCISCO, CALIF.—The Mutual Electric Light Company, San Francisco, Calif., recently held its annual meeting and elected P. B. Cornwall, president; W. R. Summerhayes, vice-president and general manager; James Fisher, secretary, and Alvinza Hayward and T. R. Henshelwood as additional directors. The annual report showed that the company's gross earnings for light service during the preceding year were $120,922.65. Officials of the company own coal mines, which enables them to compete with oil burning plants.

SAN FRANCISCO, CALIF.—The California Gas & Electric Corporation has been incorporated, with San Francisco as the principal place of business, and a capital stock of $30,000,000, of which $450,000 is paid up. The directors are: A. E. Childs, R. R. Colgate, Eugene de Sabla, Jr., R. M. Hotaling, L. P. Lowe, John Martin and William M. Pierson. R. R. Colgate will be president of the company and John Martin and E. de Sabla, Jr., vice-presidents. The new company is backed by some of the capitalists who have successfully financed and carried out the plans of the Bay Counties Power Company, which operates the longest electric transmission in the world, and the California Central Gas & Electric Company.

SAVANNAH, GA.—It is announced that the Edison Electric Illuminating Company has acquired the street railway interests in this city. The Edison Company is owned principally in Boston and Savannah. George Parsons, of New York, was president and majority owner of the street railway company. It is understood that he got more than $1,000,000 for his interest. The Edison Company now operates a lighting plant here and has the city contract. The two companies are capitalized at about $3,500,000. They will be consolidated and new securities issued. George J. Baldwin, president of the Edison Company, will be president of the new corporation.

RIDGEFARM, ILL.—The Ridgefarm Electric Light, Heat & Power Company has increased its capital stock from $5,000 to $10,000.

LINCOLN, ILL.—The Lincoln Heat, Light & Water Company, Lincoln, capital, $50,000, has been incorporated by W. A. Thomas, James W. Collins and David H. Harts.

WINAMAE, IND.—The City Council has decided to compel electric light consumers to use meters. The flat rates have been too low to pay expenses of improvements and meet interest on bonds of the municipal plant. The new rate is ½ cent per lamp-hour to business houses and ¼ cents an hour to residences.

ST. PAUL, MINN.—The Black River Falls Company, of Minnesota, filed articles of incorporation. The headquarters of the company will be at Duluth, and the object is to manufacture electric power for lighting and manufacturing in St. Louis County. The capital is $50,000.

LIVINGSTON, MONT.—At a meeting of the City Council a franchise was granted to A. O. Newton for the construction and maintenance of a new electric light plant in this city.

OMAHA, NEB.—The Overland Limited trains of the Union Pacific & Northwestern will be lighted by electricity after Jan. 1. Sixty Pullmans which make up these trains are now being equipped with electric lights, and the engines pulling the trains will have dynamos.

ALBANY, N. Y.—The Syracuse Lighting Company filed a certificate of an increase of its capital stock from $2,500,000 to $4,000,000.

YONKERS, N. Y.—The gas-contract muddle in this city, involving about $1,000,000, has brought on a spirited contest since the election of ex-Alderman Walsh as Mayor. Nearly two years ago the Board of Aldermen voted to give a contract to the Westchester Lighting Company, calling for the establishment of 1600 Welsbach lights at $30 a lamp. There was a protest on the part of some of the citizens, and Mayor Sutherland refused to sign the contract. The Westchester Company began to put up lamps, holding that the contract was valid without the Mayor's signature. The contract for electric lighting expired soon after the other contract came up for discussion, and the Aldermen refused to vote on the question of a new electric lighting contract until the gas question should be settled. The gas people put up Welsbach lamps where arc lamps had been, but the electric light people hold that they never received any instructions to discontinue their service. The Mayor now refuses to pay any bills of the Westchester Company unless it charges at the rate of $9 a lamp, the old price paid for common gas lights.

LA RUE, OHIO.—The Village Council has appointed a committee to investigate the cost of a municipal lighting plant.

NORTH AMHERST, OHIO.—The Village Council is having plans prepared for the erection of a municipal lighting plant.

LIMA, OHIO.—The Cincinnati, Hamilton & Dayton Railway has equipped a new wrecking train with an electric lighting outfit.

COLUMBUS, OHIO.—President Theobald of the Columbus Edison Electric Light Company, states that the options secured on the properties of the two Columbus lighting plants have expired and the deal is off.

SALINEVILLE, OHIO.—The Salineville Council has granted a 25-year franchise to John Goeppinger of Youngstown, who has offered to furnish arc lights at $48 per year. The town has the privilege of buying the plant at the end of ten years.

COSHOCTON, OHIO.—The Merchants' Electric Light & Power Company has complied with the law and made returns to the Secretary of State as a foreign corporation. It is incorporated under the laws of New Jersey with $125,000 capital stock. The suit brought by the State Attorney General to collect fees and penalty will be withdrawn.

OTTAWA, ONT.—The town of Fort William, Ont., is asking power from the Legislature in order to develop 1000 electric horse-power from the waters of the Kaministiquia River.

OTTAWA, ONT.—The promoters of the scheme to develop the water power at Lac du Bonnett, Manitoba, are considering the project of building an electric railway from the city of Winnipeg to that place, at a cost of about $1,000,000.

OTTAWA, ONT.—It is announced that Mr. E. Spencer Jennison, the Chicago engineer, has completed financial arrangements for developing power in the neighborhood of Port Arthur and Fort William, Ont. The scheme is a large one, and involves the diversion of water from the Kaminisquia River, to a series of reservoirs, affording a fall of 300 feet, from which 40,000 electrical horse-power is expected. To carry out the project will require about $1,000,000.

HARRISBURG, PA.—The Mount Joy Electric Light, Heat & Power Company, of Mount Joy, capital $15,000, has been incorporated.

ALTOONA, PA.—The Edison Electric Illuminating Company, of Altoona, which supplies this city with electric light, and the control of which has been the subject of litigation between it and the Electric Company of America, has finally passed into the control of the latter. A. Loudon Snowden, H. T. Hartman, Joseph B. McCall, and Frank B. Ball, all of Philadelphia, have been elected directors of the Altoona Company, together with John Lloyd and T. B. Patton, of Altoona.

SIOUX FALLS, S. D.—R. M. Parsons, an Estelline capitalist, has decided to establish an electric light system in Estelline.

HOUSTON, TEX.—The property of the Citizens' Electric Light & Power Company of Houston, was disposed of at public sale on Dec. 3, to George C. Hollister for $240,000.

HOUSTON, TEX.—The Houston Light & Power Company has filed its charter at Austin. It has a capital stock of $750,000. The incorporators are Howard C. Lewis, E. L. Carr, E. R. Coffin, H. M. Francis and Edward Clark, all of Schenectady, N. Y., and Blake Dupree and W. H. Chapman, of Houston.

SALT LAKE CITY, UTAH.—The Union Electric Light & Power Company has filed articles of incorporation. The company is capitalized at $50,000, and will furnish light and power for Cache and Hyrum counties. The company will erect plants at Hyrum and Wellsville and succeed to the old Hyrum plant.

GRAFTON, W. VA.—The Grafton Gas, Electric Light & Power Company will make a number of improvements to its lighting plant.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Bessemer Electrical Company has sold out to the Birmingham Railway Light & Power Company, the consideration being $24,000.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has commenced the conversion of its 25-mile steam loop between Bessemer and Birmingham into an electric railway laid with 80-lb. rails, and has staked off the site and ordered the erection of a $100,000 car barn at Birmingham besides purchasing the Bessemer Electric plant, on which $200,000 will be expended. The renovated and enlarged plant will supply current for the loop and other car lines.

SAN FRANCISCO, CALIF.—The latest report as to the plans of California Gas & Electric Corporation, which has been organized to take over and amplify the business carried on by the Bay Counties Power Company, of San Francisco, and its allies, is that it is about to absorb the North Pacific Coast Railroad and convert it into an electric road. It is said that the entire railroad from Sausalito, its terminal on San Francisco Bay, to San Rafael and San Quentin, from the junction to Mill Valley and from San Auselino northward 80 miles to Cazadero, will be changed over to an electric railway. An extension from San Rafael to Petaluma is among the improvements projected. The lines will be operated by current from the North Yuba transmission plant.

SAN FRANCISCO, CALIF.—The San Francisco & Piedmont Railway Company has been incorporated. The subscribers to its capital stock of $2,500,000 are F. M. Smith, F. C. Havens, W. H. Martin, E. A. Heron and W. F. Kelly. The Oakland Transit Company and the Oakland & San Jose Railway Company, with more than 100 miles of electric railway will act as feeders to the new line, which will be 17 miles in length, including the ferry trip across San Francisco Bay, and will terminate near Leona Heights, east of Oakland. The new company will give a somewhat improved service as soon as its pier and ferryboats are completed, but in order to reduce the time by one-half, plans have been prepared for laying a steel subway beneath the waters of the bay, where it is comparatively shallow. It will consist of a steel tube two miles in length extending from the end of the Oakland pier to near the shore line of Goat Island, which is occupied by the United States Government. Here it is proposed to establish a ferry landing and reduce the steamer's time to 5 minutes instead of 20. If the Government will permit, the ferries to land directly at the island the tube will be shortened ½ mile.

TAMPA, FLA.—Mr. John P. Martin, of Xenia, Ohio, is interested in a scheme to build electric railways from Tampa throughout Hillsboro County. The Martin syndicate also proposes to construct a complete system of street car lines in Tampa, and also a modern electric lighting plant. Two local companies have secured injunctions estopping the city from contracting with Mr. Martin for furnishing lights.

SAVANNAH, GA.—It has been authoritatively announced that the Edison Electric Illuminating Company has secured the street railway interests of Savannah. It is understood that Texas oil will be used as fuel by the newly consolidated company.

RICHMOND, IND.—The Richmond Street & Interurban Company will build a line from Melton, this county, to Connersville.

KNIGHTSTOWN, IND.—O. D. Ogburn and others, of New Castle, have secured from the County Commissioners a franchise for an electric railway along the National road in this county.

COVINGTON, IND.—The City Council has granted to the Fountain and Warren Traction Company a franchise. The line will extend from Danville, Ill., and will form a part of the great system that is expected to connect Danville with Lafayette, Logansport, Wabash and Fort Wayne, commonly called the tow-path line.

LOUISVILLE, KY.—Steps are being taken to construct an electric railway from Louisville to West Point, a distance of 20 miles. It is thought that a bond issue of $150,000 will be made.

DURANGO, MEXICO.—The Government of the State of Durango, Mexico, has granted a concession to Maximiliano Damm, of the city of Durango, for the construction and operation of a tramway line from Chinacates station, on the Mexican International Railroad, to the mining camp of Promontorio. The length of the proposed line is about 25 kilometers. It is probable that it will be electrically operated.

DETROIT, MICH.—The Detroit & Michigan Air Line and the Middle States Railway Company have been incorporated by the attorneys for the Everett-Moore syndicate.

DETROIT, MICH.—The Rapid Railway System (Detroit & Port Huron Shore Line) has been successful in condemnation proceedings to secure right of way for the new short cut from New Baltimore to Marine City. The new cut will shorten the distance from Detroit to Port Huron about ten miles.

ANACONDA, MONT.—The City Council has passed an ordinance requiring all railways to maintain arc lights at the intersections of streets with the railway lines.

OMAHA, NEB.—The Omaha Street Railway Company has decided to extend the line to Florence, Neb.

LEAKSVILLE, N. C.—There is a proposition to build an electric railway from Leaksville and Spray to Ridgway, Va., and possibly to Reidsville, N. C.

DURHAM, N. C.—The Durham Light & Power Company has given a mortgage to the Consolidated Railway & Light Company, of Maryland, to secure a $100,000 loan. The work on the plant will be pushed.

ELIZABETH CITY, N. C.—The Elizabeth City Railway & Power Company has been chartered, with a paid-up capital of $20,000, to construct an electric railway in the town and adjacent country. J. A. Wallace, of Berkley, Va.; C. M. Ferebee and others are the incorporators.

BRIDGEPORT, OHIO.—The Wheeling Traction Company will spend $500,000 in completing its line to Steubenville.

MASSILLON, OHIO.—Charles Currie has been elected general manager and treasurer of the Canton-Massillon Railway.

EATON, OHIO.—The Hamilton, Eaton, Richmond & Muncie Traction Company has been granted a 25-year franchise through Eaton.

CLEVELAND, OHIO.—The Middle States Railway Company, incorporated recently, has increased its capital stock from $1,000 to $50,000.

MADISONVILLE, OHIO.—The Madisonville Council has granted a franchise through town to the Cincinnati & Columbus Traction Company.

CINCINNATI, OHIO.—The Cincinnati, Georgetown & Portsmouth Railway has been authorized to increase its capital stock from $400,000 to $1,500,000.

TOLEDO, OHIO.—The Toledo & Indiana Railway has completed arrangements with the Toledo Railways & Light Company for entrance to the center of the city.

LIMA, OHIO.—The City Council has been asked to grant a franchise on North Jackson Street to the Lima Electric Light & Power Company, which operates the city lines.

CANTON, OHIO.—The Stark County Electric Railway has secured all the required private right of way between Canton and Alliance. Construction work is progressing rapidly.

MECHANICSBURG, OHIO.—The Columbus, London & Springfield Railway has obtained a franchise for a branch to Somerford, and the line is to be extended to Mechanicsburg.

LIMA, OHIO.—The Allen County Commissioners have granted franchises through the county to the Toledo & Lima Railway and the Lima, Delphos, Van Wert & Fort Wayne Traction Company.

COLUMBUS, OHIO.—The Columbus, Buckeye Lake & Newark Traction Company has filed a mortgage to the Knickerbocker Trust Company, trustee, to secure an issue of $1,500,000 of 5 per cent 20-year bonds.

AKRON, OHIO.—Daniel Gindelsperger and Frederick Green, of Cleveland, have applied for a franchise through Summit County for a road which they propose to build from Cleveland to Akron and Barberton.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Southwestern Railway, will commence construction work next spring on a line from Springfield to Yellow Springs, Clifton, Cedarville and Jamestown.

CLEVELAND, OHIO.—It is reported that the Cleveland, Terminal & Valley Railway, which is a part of the Baltimore & Ohio system, is to be equipped with electricity for the operation of suburban cars out of Cleveland.

WELLINGTON, OHIO.—The Cleveland, Elyria & Western Railway has asked the Wellington Council for a franchise to the south corporation line to furnish entrance for the proposed Cleveland, Ashland & Mansfield Railway.

CANTON, OHIO.—On the application of the Canton, Lodi & Medina Electric Railway Company, the Canton Council has established a route through town and will call for bids. W. W. Irwin, J. J. Whitacre and others of Canton are promoters.

CLEVELAND, OHIO.—Stockholders of the Cleveland Electric Railway will meet Jan. 15 to take action on a proposition to increase the capital stock of the company $1,000,000. The present capital stock is $13,000,000, with outstanding bonds amounting to $4,350,000.

MARIETTA, OHIO.—The Parkersburg & Marietta Interurban Railway has acquired three-fourths of the stock of the Marietta Electric Company, thereby securing control of the lines of the two cities. The stock was bought on a basis of $400,000 for the entire plant.

CLEVELAND, OHIO.—A dispatch from Richmond, Va., states that the Cleveland Construction Company of Cleveland has bought up the property of the Richmond Passenger & Power Company, including 85 miles of city and suburban lines. A leading official of the Cleveland Construction Company states there is no truth in the report.

DAYTON, OHIO.—The Dayton & Kenton Traction Company has organized as follows: E. M. Hopkins, Detroit, president; W. W. Steele, Detroit, vice-president; H. S. Forgy, New Carlisle, treasurer; C. L. Hubbard, Dayton, secretary; B. H. Rannells, Dayton, general manager. The main line will run from Dayton to Kenton, 75 miles.

BARBERTON, OHIO.—The Northern Ohio Traction Company has submitted a new proposition for illuminating Barberton. It offered to furnish street lamps at 3⅛ cents per hour each or 3 cents per hour each for 50 lamps on a five-year contract. Commercial lighting for 12 and 13 cents. The company is unwilling to take a three-year contract.

TIFFIN, OHIO.—The Tiffin & Southern Railway Company has incorporated at Charlestown, W. Va., with $500,000 capital stock to build a road from Tiffin to Kenton, and to maintain telephone, lighting and power plants. Incorporators: Michael Riely, Pittsburg; Allen Smalley, Upper Sandusky; D. C. Donovan, W. F. Malone and M. A. Smalley, Toledo.

CANTON, OHIO.—H. C. Fogle, one of the directors of the Canton-Massillon Railway, gives the first official verification of the report that the line has been sold to the Northern Ohio Traction Company. The stock of the road has been transferred to J. B. McCall, of Philadelphia Electric Company, Philadelphia, which represented the Everett-Moore syndicate.

JEFFERSON, OHIO.—It is claimed by residents of Jefferson that there is an excellent opening for an electric road to run through Ashtabula and Geauga counties to Cleveland. The counties include the towns of Jefferson, Andover, New Lyme, Windsor and East Orwell, with rich farming districts surrounding the towns. At present these towns are almost isolated from Cleveland because of the poor railway connection.

OTTAWA, ONT.—Electric railways between Brockville and Ottawa, 60 miles, and Cornwall and Toronto, 266 miles, are projected by the Ontario Electric Company, which will seek incorporation at the next session of the Legislature. A. L. Smith and Geo. E. Smith, of Boston, Mass., are interested.

OTTAWA, ONT.—Negotiations are now under way for the acquisition, by the Niagara, St. Catharines & Toronto Railway, of the Port Dalhousie, St. Catharines & Thorold Electric Railway. The possession of this line will give the Niagara & St. Catharines road control of all the electric railways in the Niagara Peninsula, with the exception of the Niagara Falls Park & River Railway.

AUSTIN, TEX.—There is a good prospect that the negotiations which have been pending for some time past for the sale of the two street railway systems of Monterey, Mexico, to an American syndicate will soon be consummated.

THE AUTOMOBILE.

THE NEWARK AUTO-COACH COMPANY, of Newark, Ohio, is putting on the streets large passenger vehicles capable of carrying a dozen persons.

AUTOMOBILE SHOW.—The automobile dealers of Indianapolis, Ind., have decided to give an automobile show the third week in February. Frank Stanley has been elected chairman and C. G. Fisher secretary.

THE SALEM AUTOMOBILE COMPANY, of Salem, Oregon, will establish a public automobile service early next year. The City Council recently granted a franchise to Frank N. Derby, who is at the head of the company. An annual tax of $12 is imposed on each vehicle.

A COMMERCIAL NECESSITY.—Mr. Henri Fournier, the well known French automobilist, says in the January *Success*: "Automobiling is a royal sport, as any one knows who has ridden in the chauffeur's seat of a forty-horse-power machine on a well-kept country road. But I do not plead for the automobile as a pleasure machine. I am not a faddist. The automobile is a commercial necessity. Its place is with the electric street car, the locomotive, and the traction engine.

EXHIBITION AT COPENHAGEN.—An exhibition of automobiles will be held in Copenhagen from April 11 to April 27, 1902, under the auspices of the Danish Automobile Club and the Society for the Promotion of Industrial Arts. It will be held in the building of the last mentioned society, and is designed mainly for automobiles, but some space will be given to motor cycles and articles relating to the driving of automobiles. The exhibition is intended to attract visitors from all the Scandinavian countries. No rent whatever is to be paid by the exhibitor. The showrooms, cases, and tables belonging to the society are put at the disposal of exhibitors without charge. The committee will insure a duty free import of all articles which are again exported at the close of the exhibition.

NEW INDUSTRIAL COMPANIES.

THE SHAW ELECTRICAL COMPANY, Camden, N. J., has been incorporated to manufacture electrical devices; capital, $50,000. Incorporators: J. Elliott Shaw, Wm. Gibson, George H. B. Martin.

THE NORTH CAROLINA CONSTRUCTION COMPANY has been chartered at Greensboro, N. C., to build and operate street railways, electric light plants, etc. R. Williamston and others are the incorporators. The capital is $1,000.

UNION ELECTRICAL SUPPLY COMPANY.—In noting recently the incorporation of the Union Electrical Supply Company, of 74 Cortlandt Street, New York City, the name of Mr. E. M. Zabriskie as one of the directors was omitted. He is also vice-president and treasurer.

THE RENAULT INSULATOR & ELECTRICAL MANUFACTURING COMPANY has been commissioned, its principal place of business being in Aiken County, S. C. It will manufacture insulators of porcelain, mica, clay, etc. The company will operate on valuable clay deposits.

THE MILLER STORAGE BATTERY & ELECTRIC COMPANY has been organized at Bellefontaine, Ohio, with $20,000 capital stock for the purpose of manufacturing and selling storage batteries, automobiles and electrical appliances. Those interested are A. J. Miller, J. H. Wilson, N. V. Elliott, John M. Gregory, W. W. Fisher, W. R. Niven, W. C. Huston, Geo. J. Miller and R. F. Tremain. George J. Miller, of Kenton, will be in charge of the mechanical end of the business. A factory will be established at once.

LEGAL.

POOL ROOM TELEGRAPHY LEGAL.—The Kentucky Court of Appeals has ruled that a telegraph company, as a common carrier, cannot be indicted for or restrained from furnishing information concerning races to pool-rooms. The decision was rendered in the case of the commonwealth against the Western Union Telegraph Company at Louisville.

BRUSH STORAGE BATTERY PATENT AGAIN SUSTAINED.—Judge Coxe, of the United States District Court of the Northern District of New York, has handed down a decision against American Bicycle Company interests which adds another to the long list sustaining the fundamental Brush storage battery patent of March 2, 1886. The controversy was limited to the proposition whether the electrode of the defendants in suit is of the kind described in an Italian Brush patent which has expired. The court adhered to a preceding decision that the electrodes of the Italian and 1886 patents "are different things, and one does not interfere with another." Quoting from a previous decision, the invention of the 1886 Brush patent is described as follows: "There is (1) the supporting plate; (2) the active material mechanically applied thereto; (3) the active material held to the plate by pressure, or by sheet of porous non-conducting material. It is the combination of these elements in the formation of the secondary battery which is covered by the patent in suit. By this means Brush produced the first commercial storage battery ever made." In rejoinder to the claim of the defence that their plates, after leaving the molds, are put through a long preliminary forming process which distinguishes them from the Brush electrodes, the court held that the so-called forming process is not a forming process as that term has been understood in the art and interpreted by the courts. That the active material has all been mechanically applied to the plates before being placed in the battery fluid, and there is, therefore, nothing to form, the process being simply a prolonged charging process.

OBITUARY.

GEO. H. CARLETON.—The funeral of Geo. H. Carleton, late City Electrician, of Oakland, Calif., took place on Dec. 8, the interment being at Mountain View Cemetery under Masonic auspices. Mr. Carleton was one of the most popular citizens of Oakland, and the police and fire departments and local military organizations participated in the funeral ceremonies, and made appropriate floral offerings.

PERSONAL.

MR. FRANCIS S. THAYER, superintendent of the gas and electric plants at Warren, R. I., has been appointed general manager of the Westerly, R. I., Gas & Electric Light Company.

MR. GEORGE WESTINGHOUSE has returned from England this week with very satisfactory reports as to the Westinghouse electrical outlook abroad and in time to receive the patent decision against the New York Air Brake Company as a Christmas box.

PRESIDENT S. INSULL, of the Chicago Edison Company, dismisses with scorn the rumor that the Chicago People's Gas Company has bought the property. It is an old report, anyhow.

PROF. R. B. OWENS, of the electrical engineering department of McGill University, Montreal, is on a Christmas vacation in this country. He has been very busy of late installing a new 300-kw-hour chloride battery, with other auxiliary apparatus.

MR. PHILIP J. DARLINGTON, superintendent of the Watsessing factory of the Sprague Electric Company, was married at Saturday, Dec. 21, to Miss Rebecca Mattson, of Philadelphia. Mr. and Mrs. Darlington will make their home in Glen Ridge, N. J.

MR. CHAS. BRANDEIS, of the electrical engineering department of the Lachine Rapids & Hydraulic Company, of Montreal, has been a visitor in New

York during Christmas week, for a vacation and to study the recent central station development in this vicinity.

GENERAL JOHN I. SABIN.—It is reported that General J. I. Sabin, president of the Chicago and Central Union Telephone companies, will be president of the Erie Company, and that it will be managed from Chicago. The territory is in proximity to the Chicago and Central Union properties.

PROF. F. B. CROCKER, of the electrical engineering department at Columbia University, New York City, is spending his Christmas vacation in Cuba, with the intention of shaking off in that genial climate a severe cold that has seriously inconvenienced him during the past busy Fall. He will be gone about a fortnight.

MR. JAMES RASCOVAR is now the sole surviving partner of the well known financial advertising agency of Albert Frank & Company, of which the titular senior died last August. It is stated that not long ago the firm cabled to London a 10,000-word announcement, which appeared in the London newspapers next morning. Other heavy cabling of the same kind is often done.

MR. C. D. RICHMONDT, formerly connected with the Richmondt Electric Wire Conduit Company, Waukegan, Ill., having sold out his interest, is establishing a large plant in Canada for the manufacture of conduit and electrical specialties, having taken three large buildings on Jarvis Street, Toronto, Canada. The factory which he established in Waukegan is now doing a prosperous business.

MR. HENRY FLOY, the well known electrical and mechanical engineer, has recovered from a recent protracted illness due to typhoid fever and pleurisy. He has just secured the appointment of consulting engineer to the Atlanta Electric Power Company, which is about to erect a large dam across the Chattahoochee River near Atlanta and develop electric power for transmission and use in the city.

DR. S. S. WHEELER, while attending the Lotos Club dinner last Saturday night to Judge O'Brien—re-elected for 14 years—received a long-distance telephone message that there was a fire at his big Ampere factory. Between the soup and the fish, however, he ascertained that it was limited to an outlying brass foundry, and calmly rejoined his friends at the banquet table. Congratulations were in order.

CAPT. GEORGE O. SQUIER, of the United States Signal Corps, has recently made an investigation of the sources of gutta percha supply in the Philippines, and has made a report to General Greely. He says that there are large quantities of so-called gutta-percha in the southern islands of the Philippines. The present market for the archipelago is Singapore, and not Manila. The Singapore dealers are interested that no knowledge of the subject shall be obtained, as they are looking for the purchase of whatever product can be obtained from the Philippines. None of the natives appreciate the present value of gutta-percha as a commercial product. Captain Squier recommends that immediate steps be taken to prevent the destroying of the gutta-percha trees by the natives in gathering the products, and, if a chemical analysis warrants, that a special expedition be sent out at an early date, under the general supervision of the forestry division of the Philippines, to determine the location, extent, quantity, etc., of this product.

THE FULLER FUND.—Some few months ago an effort was made to relieve the necessities of the wife and daughter of the late J. B. Fuller, the well known electrical inventor and dynamo designer, who died many years ago too young to realize any benefit from his work. We are glad to be able to record the following contributions received up to the present time: Edward Weston, $25; Thos. A. Edison, $10; Elihu Thomson, $25; James M. Kelly, $10; C. F. Brush, $25; Geo. W. Westinghouse, $100; R. H. Beach, $25; Sir Hiram L. Maxim, $10; W. Bryant, $15; C. O. Perkins, $10; Edwin Leigh, $10; F. A. C. Perrine, $25; Edw. F. Seixas, $5; H. L. Candel, $10; Bert E. Salisbury, $10; C. A. Coffin, $50; W. M. Habirshaw, $10; J. Brodie Smith, $10; Crouse-Hinds Electric Company, $10; Arthur Williams, $10; Allan C. Bakewell, $10; William F. Bossert, $10; W. M. Stanley, $25; Jos. Wetzler, $10; F. B. Crocker, $10; Cary T. Hutchinson, $10; Schuyler Skaats Wheeler, $10; L. Stieringer, $5; C. P. Steinmetz, $10; M. J. Insull, $10; C. W. Haskins, $5; Carl Hering, $5; J. F. Kelly, $5; G. H. Condict, $10.

Trade Notes.

DIRECT-CURRENT GENERATORS of the splitpole type, as manufactured by the Sprague Electric Company, New York, are the subject of Bulletin No. 102 of the Sprague Company.

THE OSBORN FLEXIBLE CONDUIT COMPANY has so many orders on hand that the factory is running day and night to keep up with the business. Mr. Corrigan is very much pleased with the outlook.

THE BURT MANFACTURING COMPANY, of Akron, Ohio, manufacturer of the Cross oil filter and the Burt exhaust head, has recently received its twenty-first order from the American Steel Wire Company, of Cleveland, Ohio.

CHANGE OF ADDRESS.—The offices of Wm. A. Rosenbaum, patent attorney, which have been located in the Times Building, New York City, for the past eleven years, will be removed on Jan. 1, 1902, to the Nassau-Beekman Building on Nassau Street.

MESSRS. BALLANTYNE & EVANS have taken into partnership M. H. S. Burroughs. The firm has offices at No. 20 Nassau Street, New York City, for the general practice of architecture, civil, electrical and mechanical engineering. The present firm name will be retained.

CABLE SUPPORT.—The Standard Underground Cable Company, Pittsburg, Pa., is manufacturing the Nordyke extensible cable support which affords a simple method of arranging the cables neatly around the sides of manholes. Full information regarding this device is given in a leaflet published by the company.

HIGH TENSION APPARATUS, as manufactured by the General Incandescent Arc Light Company, New York, is illustrated and described in Bulletin No. 53, recently issued. Various forms of high tension oil switches are illustrated, as well as the General Incandescent automatic overload-release oil circuit breaker.

THE HANDSOMEST CALENDAR of the season (in ten colors) six beautiful heads (on six sheets, 10x12 inches), reproductions of paintings by Moran, issued by General Passenger Department, Chicago, Milwaukee & St. Paul Railway, will be sent on receipt of twenty-five cents. Address F. A. Miller, General Passenger Agent, Chicago.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has prepared a question blank which, if properly filled out, will give it the exact situation in a plant. With this data it is enabled to ship incandescent lamps tested to fit the conditions as they are. These question blanks are meeting with favor and are certainly a step in the direction of good practice.

MR. JOHN T. McROY, of the McRoy Clay Works, Brazil, Ind., is issuing to his friends and customers a neat and handsome 2-foot steel rule put up in a neat metal-bound leather case, and intended to be carried in the pocket. The souvenirs of this kind issued from time to time by Mr. McRoy are always useful, and as lasting as the well-known conduits that bear his name.

PRICES ON TELEPHONES and telephone supplies can be quickly secured from the Central Electric Company of Chicago by means of its telephone price list, a copy of which will be sent to any one upon application. This company also wishes to call attention to the D. & W. telephone protector which embodies a lightning arrester, line fuses, and sneak coils. A descriptive bulletin will be sent to any one interested in this material.

ELECTROSE MANUFACTURING COMPANY, 127 North Tenth Street, Brooklyn Borough, New York, reports a steady increase in the foreign sales of its well known product, "Electrose," a substitute for hard rubber for all electrical purposes, such as telephone mouthpieces, receivers, transmitters, etc. It is only lately that the foreign buyers have been taking up this article, and the Electrose Company reports duplicate and increased orders wherever the material is used.

THE MILWAUKEE COMMUTATOR COMPANY, Milwaukee, Wis., although not an old company, has by its honest dealing and promptness in filling orders built up a business that taxes its utmost capacity. Its commutator segments are made from pure lake copper, cold drawn, true to gauge and angle, thus producing a bar of great density and hardness, calculated to stand the greatest amount of service with minimum wear. The company also makes copper and brass castings for the electrical trade.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, states that it is having an unusually large demand for its new K. P. fuseless rosette. It states that in this rosette it has one of the strongest, most practical and durable rosettes that has ever been made. It is especially adapted for 250-volt work, and is made so that the strain of the cord does not come on any connection. It is, therefore, impossible to break the connections by pulling or handling the cord. It is made in one solid piece, of glazed porcelain, and is easy to connect.

NINE HUNDRED DOLLARS FOR NECKTIES.—Last year a wealthy steel manufacturer spent $900 for neckties to give away for Christmas presents. His money would have been put to more productive use if he had bought a number of engineering scholarships in the American School of Correspondence. A scholarship in such an institution is a Christmas present worth having—and giving. A special Christmas offer is made to all new students in the full engineering course who enroll themselves during December. A hand-book of the school will be sent free to any one addressing The American School of Correspondence, Boston, Mass.

GAS ENGINES.—The Marinette Iron Works Manufacturing Company, Marinette, Wis., has recently put upon the market the Walrath gas engine. In the company's catalogue this engine is said to have very few working parts, which not only reduces the cost of repairs on account of breakage and wear, but also increases the efficiency of the engine. The engine is of the vertical crank-case type, and is built with one, two and three cylinders, and operates on the four-cycle principle. It is well adapted for both stationary and portable work, and owing to its close regulation is especially adapted for electric lighting. The catalogue contains illustrations of engines direct connected to dynamos. The largest machine shown is of 125 horse-power, and has three cylinders.

THE AMERICAN MINIATURE & DECORATIVE LAMP COMPANY has issued a forty-four page catalogue for 1902 bound up in leather. This catalogue is very fully illustrated, showing different shapes and sizes of miniature and decorative lamps. One page is devoted to surgical and dental lamps, another to special lamps for dry batteries, one of the interesting illustrations being that of a "disinfectant" lamp. Then, there are shown battery lamps with wire terminals and other lamps with bases. One page is devoted to switchboard lamps for telephone work, while another is given up to festoon lamps, requiring neither sockets nor receptacles. There are also larger lamps shown as well as candelabra lamps with both multiple and series lamps. The last few pages of the catalogue are devoted to the new electric advertising sign which has recently been brought out by this progressive company. The manager of the company is Mr. H. J. Jaeger, to whose untiring energy much of the success of the company is due.

THE JANUARY "SUCCESS" contains a number of up-to-date, timely subjects indicating the world's achievement. One of the most noticeable is the opening article, a graphic and hopeful prophecy by the famous explorer, Evelyn B. Baldwin, whose subject, "Why I am Certain of Reaching the North Pole," is instructive and entertaining. Mr. Baldwin writes that he feels certain of being successful in reaching the long sought-for spot next summer, and outlines a voyage that shows his dauntless courage and that of the forty-one young explorers who are with him. "It Transforms Forests into Newspapers," by Frank Hix Fayant, is an important paper on the newest of American industries, that of using wood pulp for making paper. In "The World's Richest School and its Purpose," Beauford A. Mason has told just what the Carnegie Institute in Pittsburg proposes to do as an institution of technical learning. Henri Fournier, the noted automobilist, whose record-breaking feats have given him world-wide fame, contributes an article on the possibilities of the automobile. A series of articles, entitled, "Business and the Larger Life," by Edwin Markham, the author of "The Man with the Hoe," "Lincoln and Other Poems," etc., begins with this number.

ELECTRIC COAL HANDLING.—C. W. Hunt Company, of New York City, issues a brochure devoted to coal handling in New York harbor by an electric

hoisting plant, which puts through some 25,000 tons annually. It is equipped with "Hunt" electric hoist and automatic railway. The coal is hoisted by means of the hoist, from the canal boats in ½-ton tubs, on a mast and gaff, to the automatic railway car, by which it is distributed in the yard. The car runs on an elevated self-acting railway and requires no steam, horse, or manual power for its operation. With the previous equipment the coal was hoisted by horse-power and trimmed into the stock pile. The old equipment cost $1,750, the new one $2,800. The cost of handling to the stock pile, interest and depreciation included, was, with the old plant, 17¾ cents per ton; with the new plant the cost is 7¼ cents. This difference of 10½ cents per ton on 25,000 tons per year makes an actual saving of $2,625. Thus every 13 months the whole cost of the plant is saved in the reduction of the pay roll. The unloading capacity with the old plant was 120 tons per day; with the new machinery the capacity is 200 tons per day, an increase of 80 tons. The power is purchased by meter at 5 cents per horse-power hour, and costs less than 7 mills for each ton of coal hoisted and delivered to the car.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED DECEMBER 17, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., New York.]

688,813. COMPOSITION OF MATTER AS A NON-CONDUCTOR OF ELECTRICITY; J. M. Ancira, New York, N. Y. App. filed July 26, 1901. The composition consists of cotton, lime and milk.

688,817. BRUSH HOLDER; W. E. Baker, New York, N. Y. App. filed Aug. 25, 1899. The brush holder is encased to confine the spring and other parts which might work loose in service, so as to prevent injury to the commutator or windings of the machine.

688,828. SPEED REGULATING DEVICE FOR OVERHEAD ELECTRIC CARRIERS; A. S. Clift, East Orange, N. J. App. filed April 19, 1901. A solenoid acting normally to hold the brake off, is in series with the motor; a shunt is arranged around the solenoid which is controlled by a gravity switch so that when the car tilts in going down grade it thereby automatically sets the brake.

688,855. EARTH CONDUCTOR FOR LIGHTNING CONDUCTORS; P. Immich, Charlottenburg, Germany. App. filed Oct. 7, 1901. An earth conductor for lightning conductors, comprising several metal bodies conductively connected with each other and with the earth-wire, said bodies being graduated both with regard to their electrical resistance and to the depth to which they are embedded in the earth or subsoil-water and forming an earth element.

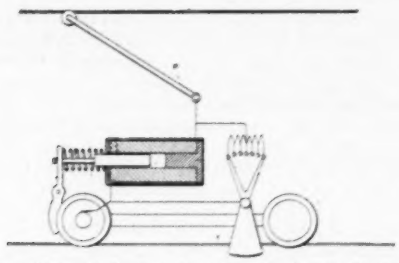
688,857. METHOD OF REGULATING WEIGHT OF METAL BLANKS; Warren Johnson, New Orleans, La. App. filed Jan. 25, 1901. Light weight and heavy weight gold blanks are separately put into an electrolytic bath through which current is passed, whereby metal is taken from one set of blanks and transferred to the other set.

688,869. MECHANISM FOR RAISING CONTACT SHOES ON THIRD RAIL SYSTEMS; S. H. Libby, Schenectady, N. Y. App. filed Aug. 24, 1897. When the car reaches a point where it is desirable to raise the shoe out of contact with the third rail, a lever attached to the car engages with a fixed cam on the roadbed and causes the shoe to be lifted, after which it is lowered at the proper time in a similar manner.

688,891. SEMAPHORE OPERATING DEVICE; J. Shoecraft, Eskridge, Kan. App. filed May 31, 1901. Details.

688,915. INDUCTION COIL; D. H. Wilson, Chicago, Ill. App. filed March 28, 1901. An induction coil having a laminated core made up of a series of short narrow strips, and completely surrounded by, and sealed up in, a non-conducting box.

688,919. ELECTROSTATIC INSTRUMENT; G. L. Addenbrooke, Westminster, London, England. App. filed June 10, 1901. Improvements in electrostatic instruments whereby the error known as contact difference is eliminated or reduced, consisting of a mica needle coated with metal foil and suspended by a wire electrically connected to the metal foil, and combined



688,828.—Speed Regulating Device for Overhead Electric Carriers.

with quadrant or sector plates having surfaces of the same metal as the metal foil.

688,922. ELECTRIC RAILWAY; R. Bingham, West Haddonfield, N. J. App. filed Aug. 22, 1901. Details.

688,935. APPARATUS FOR EXAMINING CAVITIES IN THE HUMAN BODY; S. B. Crane, Perry, Ia. App. filed March 13, 1899. Apparatus for conveniently attaching an electric lamp to a speculum.

688,964. QUADRUPLE RELAY CROSSING SIGNAL; B. N. Parrish, Jackson, Mich. App. filed Aug. 1, 1900. Details.

688,970. FIRE PROTECTOR FOR TELEPHONE CABLES; F. D. Saylor, St. Louis, Mo. App. filed May 13, 1901. (See Current News and Notes.)

688,982. AUTOMATIC ELECTRIC SWITCH; A. H. Adams, London, England. App. filed April 22, 1901. Details.

688,995. ELECTRIC HEATER; E. E. Gold, New York, N. Y. App. filed Aug. 19, 1898. Consists of an open work support designed to give good ventilation.

689,064. ICE CUTTING MACHINE; T. H. Butler and O. Hammond, Baltimore, Md. App. filed Feb. 23, 1901. An electrically operated machine for harvesting ice.

689,128. AUTOMATIC ELECTROMAGNETIC TIME SWITCH; J. Sachs, Hartford, Conn. App. filed Sept. 27, 1900. A time switch which avoids the necessity of manual winding by using a motor to actuate the switch, the circuit of the motor being controlled by a clock which is incidentally wound by the motor when the switch is operated.

689,130. ALTERNATING CURRENT METER; K. O. F. Schrottke, Berlin, Germany. App. filed Sept. 2, 1899. (See Current News and Notes.)

689,133. ELECTRIC LOCK; H. Seewald, Possneck, Germany. App. filed April 24, 1901. Details.

689,138. COVER FOR INTERIOR ELECTRIC CONDUIT BOXES; J. H. Stahley, New York, N. Y. App. filed Sept. 20, 1901. The primary feature of this invention is a sleeve fitting within the cover-opening and having two capacities for adjustment, one in line with its axis and the other angularly thereto, in order that the outer edge of the sleeve may be advanced or depressed after the box is placed in position to bring it in proper alignment with the face of the wall.

689,139. INTERIOR ELECTRIC CONDUIT BOX; J. H. Stahley, New York, N. Y. App. filed Oct. 30, 1901. A modification of the preceding.

689,141. SELECTIVE TELEPHONE SYSTEM; J. V. Stout, Easton, Pa. App. filed Aug. 3, 1901. (See page 1070.)

689,171. INSULATOR; J. F. Duffy and H. B. Bershey, Scranton, Pa. App. filed June 12, 1901. A double glass insulator adapted to supplant the pipe-arm insulator in use at the present time.

689,198. MAKE AND BREAK DEVICE; J. V. A. Kimmey, New Haven, Conn. App. filed March 30, 1901. Details.

689,199. ELECTRODE; T. B. Kinraide, Boston, Mass. App. filed May 2, 1901. An electrode having a discharge-point and means for electrically screening said point for limiting the tendency thereof to discharge.

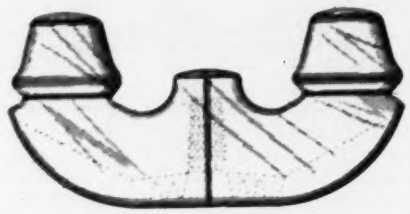
689,218. ELECTRICAL INSULATOR; Albert F. Parks, Brooklyn, N. Y. App. filed April 8, 1901. A metallic socket rigidly secured to a cross-arm carries a wooden pin to which the insulator is secured; the wooden pin has reversed screw threads at its two ends; a sleeve of insulating material surrounds the metallic socket and extends within the flange of the insulator.

689,227. TROLLEY CATCHER; C. B. Robertson, Ottumwa, Ia. App. filed March 5, 1901. Details.

689,253. METHOD OF LOCATING FAULTS IN ELECTRICAL CIRCUITS; T. W. Varley, New York, N. Y. App. filed March 30, 1901. (See Current News and Notes.)

689,254. APPARATUS FOR LOCATING FAULTS IN ELECTRICAL CIRCUITS; T. W. Varley, New York, N. Y. App. filed March 30, 1901. (See Current News and Notes.)

689,278. ELECTRIC CONDUIT TERMINAL; W. F. Bossert, Utica, N. Y. App. filed June 4, 1901. A beaded bushing.



689,171.—Insulator.

689,286. MANUFACTURE OF SOLUBLE PHOSPHATES; Guillaume De Chalmot, Leaksville, N. C. App. filed Dec. 21, 1895. Renewed Nov. 23, 1901. Natural phosphates are mixed with silica and heated in an electric furnace; the phosphoric acid driven off is then recovered. The patent is almost identical with one issued to the same inventor in 1897.

689,321. TROLLEY; T. McWilliams, Kings Park, N. Y. App. filed March 6, 1901. A pilot wheel is used in front of the main wheel, to cause the latter to follow curvatures in the trolley wire.

689,335. JUNCTION BOX FOR ELECTRICAL CONDUITS; R. M. Thomas, New York, N. Y. App. filed June 20, 1901. Details.

689,353. PROTECTIVE MECHANISM FOR SYSTEMS OF ELECTRICAL DISTRIBUTION; R. V. Cheatham, Louisville, Ky. App. filed May 23, 1901. The invention consists of means thrown into operation by a breakage of one of the conductors of the system for grounding the other conductor, and thereby throwing into operation a circuit breaker and automatically cutting off the flow of current to the system.

689,356. ELECTRIC ARC LAMP; C. Eschwei, New York, N. Y. App. filed March 27, 1901. Details.

LIBRARY OF THE UNIVERSITY OF CALIFORNIA